THE AMERICAN

JOURNAL OF PSYCHOLOGY

Founded by G. STANLEY HALL in 1887.

VOL. XVII. OCTOBER, 1906. No. 4.

JEALOUSY.

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There is a good, old-fashioned maxim which says, 'Envy no man.' But there are a hundred old sayings which make mock of the maxim. There is a French proverb that 'The envious die but Envy never;' a Latin proverb that 'Envy never has a holiday;' a German proverb that 'No one lives who does not envy;' a Danish proverb, 'If envy were a fever, all the world would be ill!' Another proverb declares, 'There is no man, however high, but is jealous of some one, and there is no man, however low, but has some one jealous of him.' In addition, there are the sour-grape, and the dog-in-the-manger fables, the evil-eye folklore, and a wealth of fairy

tales about envious stepmothers and jealous queens. 'Do ye think that the Scripture saith in vain, The spirit that dwelleth in us lusteth to envy?' The subject of our study is something very deep and universal in human nature. Indeed, jealousy is so ancient that it existed before human nature itself, as witness the present day manifestations of this passion in the lower animals.

I. The Psychology of Animal Jealousy.

When through the stress of competition, animals come to feel antagonism and discomfiture in rivalry situations, they may be credited with jealousy; at least, in accordance with our definition. Omitting all speculation about love, hate, and sex feelings in atoms, crystals or plants, it may be safely said that the three primordial animal instincts about which all others cluster, are the self-preserving, the pairing, and the parental. At the lower end of the animal scale, where Nature is bountiful, where the conditions of life are comparatively simple, these three instincts, so far as they exist, remain comparatively simple, both in their operation and their psychic equivalents. As we approach the vertebrates, however, the creatures and the conditions of their survival become more complex. The fundamental impulses lose their original unblended character, or become associated with complicated activities, developed in response to the more difficult situations. As the biological behavior grows more complex, new psychic states come into existence, and fear, surprise, or anger make their first appearance. Something like a rudimentary jealousy is probably present among the arthropoda. "Even insects," Darwin says, "express anger, terror, jealousy and love by their stridulation." (9, p. 350.) Pocock attributes anger and jealousy to the spider. As many as five male spiders have been observed on one web after the same female, and Dr. Porter reports one case where the male achieved his mate only after vanquishing two rivals in two successive combats. (33, p. 347.) Among the crustacea there seems to be a high degree of emotional life. Pliny credited the pea-crab with jealousy. Lobsters are known to monopolize a special corner of an aquarium and jealously to expel intruders within a certain sphere of influence. Crabs fight vigorously for the same morsel of food, and show a tendency to clutch the morsel and swim off with it, guarding themselves with the free mandible. Hermit crabs often make disturbances in aquaria, because of a sort of restless jealousy which impels a strong individual to leave an apparently good shell and evict perhaps a half dozen of his neighbors from their domiciles, in succession, after as many encounters.

But coming at once to the vertebrates, Romanes is certain that jealousy appears in the very first class of this division. "Jealousy, anger, and play unquestionably occur in fish and batrachia." The stickleback is a good example. He will enter battle against rivals for a female; he will appropriate to himself a portion of the sea and furiously attack any other stickleback who may cross the frontier; changing color from rage, he will seize an enemy by the fins and lash with all his strength when a brood of fry are in danger. (35, p. 245.) The proprietary instinct, as Letourneau has shown, is closely related to jealousy, and becomes well developed among the back-boned animals. The lion assumes a large forest preserve upon which no other may trespass, but on pain of battle; aurochs collectively take similar authority over their feeding area; the pariah dogs of the East have their beats which they strictly police; monkeys and even the birds of the air have their hunting grounds. Besides this ownership in domain, there is the hoarding instinct, found in the rat, squirrel, hamster, and mole, who not only burrow spacious underground dwellings but fill them with a store of winter food. The same is true of birds like the shriker, the woodpecker and the owl, who buries its surplus provisions like the dog. (27, p. 422.) Furthermore, there is a widespread property in dwellings, "The bear has his cavern, the badger, rabbit and mole their subterranean home, the lion his den, almost every species of bird its nest, the beaver its lodge; the dog, fox, coyote, cat. tiger, and leopard all build temporary homes for their young." Among all these animals there is a stern struggle for existence, where appeal must often be made to the ordeal of battle. This property in food, domain, dwellings, and we may add in mates is not inherited, nor does it even come by the mechanical working of a proprietary instinct; it must all be acquired against rivals, and once acquired it must be watchfully guarded. In such a fertile soil of competitive strife, aggresive and defensive, —against fair rivals on the one hand, and intruding contestants on the other,—the feeling of jealousy which is such a useful ally to both offensive and defensive warfare, would strike deep root.

With this general statement before us, we may present in greater detail, cases of jealousy in animals of different species. Delbœuf reports an interesting case from the reptilia, the second lowest vertebrate class.[1] (12.)

[1] The descriptive accounts of cases of jealousy are printed in smaller type, not because the writer considers them subordinate in importance, but only to differentiate the same from the body of the article, and to economize space. The sex of the cases is indicated throughout by B and G or M and F; the age, by the figures following.

He owned two pet lizards, both males, who lived on the best of terms with one another, and slept side by side, often interlocking. But no sooner was a female introduced than "Pedro conceived a great antipathy for Pierre, which became more evident every day, tormenting him till I was obliged to make a separate cage for him." This is a clear case of sexual rivalry, as is the following of food rivalry. "My lizards did not vary from the general rule. The best worm was always the one that a comrade had. If it was long we might witness such a steeple chase as is seen sometimes in a poultry yard." "Pedro was (also) jealous of my preference and caress. When he was on my sleeve I could keep him for hours motionless by passing my hand lightly along his body; but if I took Pierre or another lizard up, his rage broke out at once and he would jump upon him with his mouth menacingly wide open." This would seem to be a case of rudimentary affection jealousy.

Next in the scale we come to birds, whose jealousy is proverbial. "That they also manifest the kindred passion of emulation," says Romanes, "no one can doubt who has heard them singing against one another." Darwin and Morgan both allude to the fact that song birds, when matched against each other, will sometimes sing to exhaustion and even to death. The rivalry of male birds in courtship is so ferocious that it freqently results fatally to one or more of the contestants. Especially is this true among wild birds, and it has been observed that an ordinary barnyard rooster will tolerate a rival in the yard, whereas a jungle fowl would kill him. But the fierce competition for food so commonly seen in the poultry yard shows that the spirit has not altogether died out of the domestic species. Pigeons kept in a coop will take possession of a certain proportion of perches, nests and space, which they will guard against infringement. Kingbirds and sparrows will also guard domain, and eagles assume feeding grounds. Just as the jealousy of the males flames up in the season of mating, so the pugnacity of the females comes to the surface at the period of brooding. The white shafted fantail "is a lively and amusing little being, singularly bold and confiding in character, betraying little fear of man. These attributes, however, entirely disappear during the breeding season, when the little bird becomes as suspicious and timid as it was formerly bold and confiding. It cannot endure that a human being should even approach its nest." (Wood.) The ordinary barnyard hen in the midst of her brood is a walking incarnation of maternal jealousy. She will even peck at unoffending chicks, which belong to a brood other than her own. But more highly developed, and more difficult to interpret than these jealousies for food, mates and offspring, are those manifestations which proceed apparently from slighted affections. Romanes quotes such a case as occurring in a cockatoo, who showed jealousy "at the sight of his mistress carrying on

her wrist, and stroking affectionately, a little green parrot." I shall report only one more such case, which I have directly and in detail, from an accurate observer.

The bird in question is a small, beautifully colored Cuban parrot, of highly imitative, talkative, and assertive temperament. The affectionate side of her nature is well developed. She was adopted as a pet when six months old, and since then she has had no relations with birds of her own or stranger species, except as she sees them fly past the window, and these she fears. Consequently her affections, so far as she has any, must be expressed with reference to cats, dogs, babies and adults, including especially the members of the household. Those who win her favor are rewarded by a low chattering, or by the gentle caressing of her bill, with which she gently rubs over your eyelashes or lightly explores the chambers of your ears. These are the unmistakable signs of affection. Now the remarkable feature is that the bird is almost whimsical in distributing them; she has her likes and dislikes. With some strangers she takes up readily, with others not at all. For babies she never shows any antipathy; but let her mistress only pet a cat or a dog in her sight, and she is beside herself with rage. Her eyes dart fire, her feathers ruffle, her wings distend, she shoots from her perch and bites the cat or dog with her beak. Cease the provoking petting of her rival and she is appeased.

Now from all the inquiries I could make, there is no other principle of interpretation possible here, but jealousy. Suggestion, imitation, fear, pure pugnacity, or desire for food,—all or any of these are inadequate as an explanation. And what is most conclusive is this fact, namely, that if a *stranger* should pet the rival cat or dog, the jealousy reaction is not as intensely excited as when the favorite mistress of the parrot does the petting. Something like a rudimentary affection jealousy must here be present, and it becomes conceivable when we recall that the parrot by virtue of its gregarious ancestry is an extremely social bird, "and stands at the very top of the whole feathered world for the development of its intelligence."

Proceeding now to the mammals, we are at once confronted with the intense sexual jealousy of the male sperm whales. 'In their battles they often lock their jaws together, and turn on their sides or twist about so that their lower jaws frequently become distorted.' (8, ch. 18.) The next case, cited, is from the ungulates, an unhandsome, but not unconvincing example in the pig. It is taken from Robinson, who has a genius for observing homely barnyard facts. (34, p. 221.)

"When a pig is alone in a sty he will often take his meals in an indifferent and leisurely manner, and, as often as not, if abundantly supplied with 'wash,' he will leave some of it in the trough until it becomes stale and uneatable. But when several are domiciled together, the beautiful influence of competition, which we so often admire in human affairs, comes to the aid of the farmer. The instant that the pail is emptied into the hog-trough there is an eager rush to the spot, each pig thrusting its fellows aside, and plunging its snout deep into the fluid in order to get as much property as possible into the only strong room he knows of where his goods are in peace."

Even the docile sheep shows the same competitive tendency in feeding. Horses are very susceptible to the influence of pace making, and they, like oxen, are reported to be jealous of favors of food or affection shown to companions. (45, p. 46.) Horses sometimes manifest a tendency to become jealous sentinels, in a manner reminiscent of the ancestral herd life. Thus one old gelding is reported to have made himself vigilant guardian over a young mare, whom he never left while grazing and whom he always protected from other horses. Another horse extended his guardianship over all the young colts in the pasture, and though otherwise of a gentle disposition, jealously repelled all intruding horses by kick or bite.

Some of the most precious examples of animal jealousy are doubtless to be found among monkeys, but the number of trustworthy observations on their emotional life is still sadly deficient.

Lieut. Schipp in his Memoirs (35, p. 493) relates of a Cuban monkey, "He quite understands the meaning of shaking hands. . . . To-day he had been a long time playing with his toys, taking no notice of any one. Suddenly my mother remembered that to-day was my birthday and (for the first time since he came to the house) shook hands with me in congratulation. He immediately became very angry with me, screamed and chattered and threw things at me, being evidently jealous of the attention my mother was paying me."

R. L. Garner, in his book on Apes and Monkeys (p. 163), gives an amusing case of which the following is a condensed account:

Aaron and Elisheba (male and female) are sitting on top of the ship hatch, absorbed in gnawing turkey bones. Along comes a big rival ape. Aaron looks up in surprise, but Elisheba hardly notices him. Big Ape takes seat to right of E. (A. being on the left). When Big Ape is settled, A gets up, walks over, and crowds in between them; then the Ape in turn gets up and deliberately sits on the other side. This performance is repeated six or eight times. A. struck blows at his rival, but in a half jocular, embarrassed manner. He gave no signs of anger, but made no effort to conceal his jealousy."

E. D. Cope, in the American Naturalist (Oct. 1890), relates a case in a chimpanzee, who, when his keeper intentionally neglected him at feeding time to the advantage of a companion monkey, "showed his displeasure by pouting the lips, and finally he would rush from the side of the keeper, and throwing himself on his back would give way to a burst of jealous rage. He kicked his feet, threw straw into the air, and screamed vigorously, the whole proceeding resembling what we sometimes see in a spoiled child. On the offer of renewed attention from the keeper, the chimpanzee was pacified."

It is fortunate that we have with us such convenient objects for study as the cat and the dog, the one representing excellently the gregarious, the other the solitary group of animals. The dog is an especially valuable specimen from our standpoint, since he is so expressive of his emotions, an expressiveness which was developed for its utility in the aboriginal pack life, and has been for centuries conserved by man. The typical dog is by nature such a sympathetic and affectionate animal

that he craves attention, and mere indifference or neglect is a punishment; often he loves a caress better than a biscuit. The stimulants to dog jealousy are correspondingly many and various, including not only material benefits, but attentions to all rivals, whether canine, feline, or human. I have noticed signs of jealousy even at the bestowal of mock affection upon an inanimate object like a chair. A fox terrier flew at visitors like a small fury, because they noticed to his neglect, the cunning tricks of a rival. Another male terrier became so dangerously jealous on the arrival of a baby into the household that he had to be put out of the way. Another regarded a pet lizard as a rival and was so keenly jealous that the mere mention of the word "lizard" would rouse the dog to walk excitedly about the room, and bark for as much as ten minutes at a time. Still another dog, who was on friendly terms with a kitten when both were left alone, would interpose if the kitten was petted, would pick her up and deposit her outside the range of the caresser's favor. A contributor to Science (Nov. 25, 1892) reports a case in which the dog did not deal so gently:

"My brother owned one (dog), a well grown, bright fellow, who was usually upon excellent terms with my kitten, but showed jealousy if the kitten was petted in his presence. On one occasion I held the kitten in my arms and purposely petted and praised it while the dog's eyes kindled ominously at the pretended neglect of himself. Suddenly the kitten jumped from my arms to the floor, and before I could interfere the dog had seized and shaken the life out of it."

Another case, to all appearances as decisive, and the details of which I was able to get directly, soon after its occurrence, may be quoted here for its trustworthiness and instructiveness.

This time it was a handsome, mahogany-red Irish setter of famous Elcho strain, an affectionate, sensitive dog who lived with his master from early puppyhood. For some ten years, in every weather, it was his habit to accompany his master twice a day, to and from the store, remaining during the business hours near or under the master's desk. But one day a very young kitten strayed into the store. For possibly three weeks it remained hidden under the boxes in the shop, and then, in response to kind treatment and food, cautiously and gradually came out from behind its retreat. During this period of concealment the dog, Rex, who was daily in the shop, must have known the presence of the visitor by the sense of smell, but he evinced no excitement until the kitten had assurance enough to show itself and to play about his master's feet. The kitten was very small, unoffensive, and timid rather than pugnacious, while Rex, it should be mentioned, was a courageous dog who delighted in chasing cats. The master refrained from aggravating any resentment, treated Rex in the usual manner, and did nothing to the kitten beyond feeding it, and occasionally taking it up in his lap. But this was too much for Rex. Day by day he showed clearer signs of his discomfiture, snuffing in a suspicious manner and watching askance for the appearance of the kitten as soon as he entered the store. His accustomed position was

under the desk, near the end of a long, narrow shop; but day by day as the cat emerged from its seclusion, *he* made a gradual retreat. Finally, after about two weeks of this gradual withdrawing, he refused to enter the shop altogether, and remained outside, casting furtive glances through the window. But after a few days he surrendered even this outpost. He would accompany his master every day as usual, but on reaching the nearest corner, fifty yards from the store, he deliberately stopped, eyed his master till inside the door, and then turned home. This was his daily behavior for a long time, until his master gave away the cat, and urged him back into the shop. Thus, almost as gradually as the kitten itself emerged from the background, did the dog retreat from a position he had held for years, finally to surrender it completely to his inglorious rival.

There are many interesting questions arising in connection with manifestations of dog jealousy. What is the earliest age at which a dog shows the first unmistakable signs of jealousy? Six months seems to be a conservative opinion, excepting, of course, the slight amount of jealousy found in the fighting plays. What breed of dogs are most susceptible to jealousy? And why? Is there any difference between mongrels and pure strains in this regard? Dr. Wesley Mills, of McGill University, Montreal, in an interesting letter, from which I take the liberty of quoting, has some observations on these points based on wide experience with cat and dog psychology.

"I think the Irish setter ranks high in affection, but whether the collie be more affectionate than other dogs, he is certainly above all others the dog of his master, and sometimes of one master, that is to say, he never becomes attached to a second master as to the first. Collies are also, perhaps, the most jealous of all dogs. I had in my own kennel some years ago a very remarkable instance of this. A young collie which came into my possession when ten months old, in the course of a year or so developed such jealousy that scarcely a single dog in the large kennel I had dared lift up his head. To such a pass did matters come that, although the dog was a valuable one, both as regards breeding and intelligence, I was obliged to part with him.

"The chief difference between mongrel dogs and pure breed dogs I can best express by saying that a pure bred animal is often a gentleman and a specialist, whilst the mongrel may be compared to a sort of a jack-of-all-trades with considerable intelligence and comparatively little refinement of feelings. The pure bred, I think, feels more than the mongrel, but whether he is more jealous I hesitate to say. The subject is complicated by many considerations involved really in the above general lines of distinction.

"My observations on cats are not so numerous as on dogs; but I have little doubt that they are, to some extent at least, jealous, though certainly not to the same degree as dogs."

To consider a moment this question of cat jealousy. The cat, it must be remembered, is not a social animal like the dog, a difference which is important from our view point, and expresses itself in many ways, *e. g.*, behavior in eating. Quoting from Robinson (34, p. 229).

"The way in which a cat takes its food is a sure sign that, in its natural state, it is not in the habit of associating with greedy companions. When given something to eat, it first carefully smells the morsel, then takes it in a deliberate and gingerly way and sits down to finish it at leisure. There is none of that inclination to snatch hastily at any food held before it, which we observe even in well-trained dogs; nor does a cat seem in any hurry to stow its goods in the one place where thieving rivals cannot interfere with them. Indeed, no greater contrast in natural table manners can be observed anywhere than when we turn from the kennel or pigsty and watch the dainty way in which a cat takes its meals."

This difference in feeding habits is fundamental and very interesting. In the matter of sexual rivalry possibly the cat shows a greater development, while in parental protection there is no great difference. The jealous proprietary and hoarding propensities manifested by nearly every watchdog are, however, largely lacking in the cat. In matters of affection, in spite of its proverbial 'cat love,' the cat's conduct often resembles that of the dog. Jealousy is aroused in the same general manner, but with less frequency, by caressing another cat, dog or human rival. Occasionally cat and dog in the same household are mutually and reciprocally jealous of each other. If Lindsay can be trusted, a mother cat may torment by biting and cuffing, and even kill, one of its own offspring which happens by its cuteness to attract all the attention to itself.

The writer was able, as in the case of the dog, to get trustworthy details in regard to one instructive, if not typical, example of cat jealousy.

This cat was a sturdy, black, double-pawed, male animal, eleven pounds in weight, of affectionate disposition, lively and nervous. Adopted when two months old, a lean, pitiable looking kitten, he grew up under enviable attentions. Says Mrs. X., his mistress, 'I tended him as well as a child, gave him a bath as regularly as I would a child. He took the place of a child to me; but when the baby was born everything was changed for me. I didn't have time for the cat any longer.' It should be mentioned also that the kitten was unsexed when about three or four months old, that he had little society with others of his kind, and that most of his whole existence, emotional and material, centered about the home and about Mr. and Mrs. X., who, as stated, treated him like a child. All this would have an effect on the cat's psychology and help explain his subsequent behavior. When the baby was a day or two old, the cat sniffed up to the cot where it lay wrapped up in a shawl. The cat soon began to growl ominously, to spit, and made signs of cuffing it, but was prevented, and then ran to the door and importuned to get out. After that experience the cat would no longer stay in the house as a regular, peaceable pet, and his behavior was visibly changed. He would scarcely allow Mrs. X. to pet him any more, and would *not* permit her to take him up in her arms. Whenever, for any reason, the baby became the centre of attention, he suddenly went to the door and mewed to be let out. Let the baby cry and he became restless. If the door was not immediately opened, he pawed at it, and raised his voice to a howl, swished his tail, and so persisted that for very nui-

sance the door was opened. His actions indicated discomfiture rather than rage or grief. Once out, he made for the neighbor's barn, where Mr. X. worked. When Mr. X. returned from his work, the cat followed him home, but never to remain long. With time he grew more and more reluctant either to follow or to stay, and accompanied Mr. X. only half way home. Finally he disappeared altogether. But prior to his final disappearance, there was an event, which increases for us the value of this case. When the baby was four months old, the mother left for a visit and remained away nine weeks (as if on purpose of experiment to put this interesting case to a test!). The cat responded to the test, came back and resumed the even tenor of his previous peaceable ways. But on the return of his baby rival, the place again became intolerable, and he deserted it completely, as related.

Nature and Function of Animal Jealousy. With these examples before us, a fuller discussion of the character of animal jealousy is possible. We defined jealousy as arising from a conflict of interests (rivalry). Now manifestly in animals, the conflicting interests are not reflectively considered or comparatively perceived; in other words we do not have that higher reflective emotion which man can boast, but have instead, something more automatic, something direct and instinctively inherent in the organism; we have, to use Baldwin's terms, organic or instinctive emotion. At bottom, however, all feeling in man as well as in animals is instinctive. Admitting the concept of evolution, we can by no distinction divorce animal from human emotions. We must infer that the feeling life of beasts is, in some dim way at least, like our own. The impenetrability of consciousness forbids our saying or thinking anything very different.

If Nature, by some Utopian adjustment, had allotted but one male to every female, given each pair its measure of land, air and sea, and then put up cordons protecting every family from every family, the rich life of feeling would never have developed. Under such an arrangement, the specific instinctive activities might all exist just as now; the animals would be hungry, would breed and rear their young, but mere Cartesian mechanism would suffice. Jealousy, of all things, surely would not exist, for it is unthinkable without strife. It is precisely because Nature established no such quiescent equilibrium, but thrust her beasts, birds and fish into a rivalry where vigilance was often the price of survival, that jealousy appeared upon this earth, and appeared early.

Says Morgan, "Whatever may be the exact psychological nature of the emotions, it may be regarded as certain that they introduce into the conscious situation elements which contribute not a little to the energy of behavior." Indeed, is not this the very reason for their existence, at least in the animal world? Darwin, once or twice, seems to go even farther in

the attribution of utility to the emotions of pugnacity and jealousy, for he speaks of them, not only as being the correlates of male sex, strength, and beauty, but as having a causal effect in producing the secondary (male) sex characters. (8.)

The various emotions, then, are allies, which the agency of natural selection has furnished to stimulate and intensify instinctive behavior. Of two candidates for survival, both equally equipped with the biological modes of action, that one who had the better *psychological* equipment in the way of feelings to energize his action would win the palm of existence. In a state of rivalry between individuals and species the possession of mere ability to eat and to pair could not insure existence. Vigilance, combined with pugnacity, was the prerequisite of survival, and those creatures who had the least amount of vigilant jealousy suffered the 'stern fate of elimination.' Viewed broadly, jealousy seems such a necessary psychological accompaniment to biological behavior, amidst competitive struggle, that one is tempted to consider it genetically among the oldest of the emotions, synonymous almost with the will to live, and to make it scarcely less fundamental than fear or anger. In fact, jealousy readily passes into anger, and is itself a brand of fear.

Relation of Jealousy to Other Instincts. We have spoken of jealousy, both as an instinct and as an instinctive emotion. The latter term may be more satisfactory, because 'instinct' connotes some specific biological activity, whereas jealousy rather suggests a general, plastic store of emotional stimulant. In a few cases, however, the principle of jealousy seems to have crystallized into a definite instinct. The queen hive bee is possessed of an instinct which drives her to destroy the female cells before they are hatched, to forestall, as it were, future rivalry. The common tomcat has been known to strangle the males of his own litter, when they are but a few weeks old, long before they, his potential competitors, are mature. A fledgling cuckoo will eject eggs and nestlings from the home of its foster parents. Again, jealousy is particularized in the sense that the most critical situations bring it out most strongly, and there is always a special increment at the pairing and breeding seasons.

Jealousy, as we have indicated, is closely connected with the *proprietary instinct* in general; it is related not only positively with the desire to appropriate, but negatively with the capacity to feel imminent and actual disappropriation. Letourneau makes both envy and jealousy an exacerbation and outgrowth of the instinct of property.

The relation which jealousy bears to instinctive *sympathy*, would be fruitful to trace out in detail. Sympathy was devel-

oped like jealousy as an organic emotion, which furthered the survival especially of gregarious animals. Unlike sympathy, jealousy is anti-social, but not without having a place in the economy of things. "As a complication of sympathy, also considered as instinctive in animals (jealousy)," says Baldwin, "would seem to be a necessary outcome of the law of utility, for the dog whose sympathies for another had no such modifitation would stand by and perish while others lived, whenever the competition for food was sharp. His delight would be to see others eat." (1, p. 235.)

In the course of events it is likely that individuals arose who had a Quixotic fund of jealousy, disproportionate to their interests; but these would perish, and in many species, natural selection, to check such unsymmetrical development produced the instinct of caution and *bashfulness*. Just as jealousy may be considered an antidote to offset the disadvantages of an overdeveloped sympathy, so bashfulness and caution, which are a differentiation of fear, can be regarded as a counterpoise for a too aggressive jealousy. That peculiar form of bashfulness found in the female and called *coyness*, on the other hand, may be regarded as a stimulant to jealousy.

Another influence which has been of great importance in offsetting and reducing the scope and strength of jealousy is the instinct of *mutual aid*, which, as Kropotkin has pointed out, is a factor in evolution on a par with mutual struggle. It is the latter which favors the growth of jealousy, while with the former are associated the amenities of sociability, and peacefulness. To quote a few examples from Kropotkin's work: 'The little Egyptian vultures live in close friendship. They play in bands in the air; they come together to spend the night, and in the morning they all go together to search for their food, and never does the slightest quarrel arise among them.' 'Pelicans fly to their resting place, always the same for each flock, and no one has ever seen them fighting for the possession of either the bay or the resting place.' 'Sparrows announce and share food.' Life in animal societies even develops 'a certain collective sense of justice growing to become a habit.' (29, pp. 22-24, 58-59.) "Separate groups of penguins have separate resting and separate fishing abodes, and do not fight for them." Bank swallows are very congenial, even when there are more birds than resting sites. The migration of birds also furnishes fine examples of co-operation and sympathy.

Adolph F. Meyer, a sympathetic but careful student of bird life, writes of the white throated sparrows (during migration) as follows: "They are about the most loving and peaceful birds I know,—like the swallows but with more 'soul life.' I

can imagine no more impressive scene of loving tenderness than a flock of white throats cuddling together in a brushheap at eventide and with soft brooding notes of cozy companionship going to rest for the night. This scene, and their rather soft tremulous song, have so endeared them to me that I can hardly imagine white throats ever to be jealous."

Here, then, in sociability and mutual aid we see the other side of the shield; but jealousy, however anti-social it may be, retains a function in zoölogical economy; namely, to conserve the individual as against the group. It is Nature's great corrective for the purely social emotions.

In this connection arises the interesting question, whether solitary or social animals have the greater development of jealousy. The question is complicated by the fact, as Kropotkin has pointed out, that "it appears probable that apart from a few exceptions, those birds and mammals which are not gregarious now, were living in societies before man multiplied on the earth and waged a permanent war against them or destroyed the sources from which they formerly derived food." (29, p. 52.) It seems, also, that solitary animals will combine on occasion, as lions in hunting. Gregariousness increases the general amount and expressiveness of emotion, and develops sympathy and sensitiveness; this, combined with the fact that social animals are more frequently confronted by rivalry situations, would tend to the conclusion that they are more jealous. They surely have more capacity for affection jealousy, as witness the parrot, crane, and dog, and we have already referred to the jealousy of canine 'table manners.' In regard to sexual rivalry there appears to be no such difference. The number of cats observable exceeds the number of dogs, and the fact that they are much less frequently credited with jealousy is significant.

Mutual aid within a gregarious group by no means excludes the operation of mutual struggle with its attendant jealousy, and Kropotkin himself cites the quarrelsomeness of the social rats in our cellars, and of the social morses, which are prone to fight for the possession of a sunny place on the shore. Moreover, it should be noted that the operation of the mutual aid law is confined within a group, or a species, and does not prevent but often intensifies the struggle between groups and species. Thus sparrows may share food, but they will fight with fierce jealousy to keep a domain free from strangers.

The Factor of Sex, like that of sociality, is difficult to evaluate. In the matter of food rivalry its influence is slight or nothing. In sexual rivalry, jealousy is largely confined to the male, except in such few cases like the cassowary, mentioned by Darwin, 'where the female takes the lead in court-

ship, and plays the part of the male throughout, exhibiting all the worst of his passsions, such as rivalry, jealousy and ferocity, the rivalry and jealousy leading to frequent battles for the possession of the male.' But whatever effect the mating season may have in increasing the jealousy of the males, this is partially compensated for by the demands which the breeding season usually makes on the female in watching over and protecting her young. Finally, it is well to note that jealousy is exhibited in unsexed animals,—emasculated cats, spayed bitches and geldings.

Expression of Animal Jealousy. There are two characteristic modes in which animal jealousy expresses itself,—excitation of the creature, or depression. Just as in the social human there is what has been called 'a sense of other persons,' so in the higher animals there is 'a consciousness of kind,' and an instinctive sense of a rival's presence. The experience may be momentary or prolonged; if it is colored with the proper stenic or asthenic reactions we have jealousy. A worm is thrown to a couple of Lloyd Morgan's chicks. "Instead of quietly and leisurely dealing with the worm in accordance with its special meaning as it (a chick) does when there is no rival in the field, the chick darts at it and bolts with it in accordance with the special meaning which its neighbor's presence under such circumstances, has acquired. And this difference is in the conscious situation,—the interest of which is centered in the companion."

In the lower and more usual forms, the expression of jealousy is of this positive, aggressive nature. First comes the perception of the situation of rivalry, and then with instinctive promptness, for the reaction is organically ingrained, the bucks lock horns, the chicken bolts, the fish makes a lunge, etc. There is an instantaneous toning up of the muscular system; the heart beats faster, blood sets to the head, breathing accelerates, the eyes kindle and the whole organism tingles ready for onslaught. If the onslaught immediately follows,the jealousy passes into rage and we have the jealous rage or raging jealousy; if not, we have what appears to be a painful state of 'obstructed conation,' of 'thwarted impulses,' of nascent fear and anger, or of vigilant preparedness.

As the situations become more complex, and as the animal's emotional nature becomes more highly developed, the jealousy reaction is not always simple. Take dogs, *e. g.* The manager of a Pennsylvania kennel writes me as follows: "The different modes of expressing jealousy by dogs and other animals, we consider depends on the disposition of said animals entirely, as you will find almost as many different dispositions in animals as you will in persons. Through jealousy, a dog,

for instance, if he be of an aggressive nature, may become very much so toward the object of his discomfiture, but if he is of a tender nature, and much devoted to his master, he may through jealousy, just sit and cry or go away and mope by himself over his grief and in some cases refuse to eat." Almost any one can substantially verify the statements of this observer. We should insult the psychology of the dog, if we expected the same stereotyped jealousy reaction in the ponderous mastiff, the leisurely spaniel, the dainty lapdog, the nervous terrier, and sensitive collie. Moreover the individual differences in specimens within the same variety, yes, the same litter, are marked. Anger symptoms are, naturally, the most common and need not be reviewed, but in addition to angry biting, etc., we have whining, howling, whimpering, moaning, subdued barking, pawing, rubbing, retreating, nervousness, nosing, squirming, restless pacing, frisking, performing of tricks as though to attract attention, interposing with paws, slinking, hiding, crowding, licking, swallowing (apparent lump in throat), dropping of head, tail and body, rolling of eyes, loss of appetite, moist eyes, tears,—and combinations of expressive movements difficult to describe, but which are popularly made to indicate moping, despair, dejection, sorrow, sulking, etc.

The group of depressive symptoms taxes our power of explanation more than the excited. To say that the former show wounded feeling, or slighted affection, perhaps connotes too much. Yet they plainly bespeak a painful emotional state. Skye terriers (one of the most jealous breeds) have been known to shed tears freely, and instances of dogs pining away from grief, in such cases are reported. (14, p. 181.) That they refuse food is beyond doubt, and I have known of at least one dog with ample opportunity to eat, who grew fatter as soon as his rival left the premises.

An interpretation of animal jealousy will be attempted in a future section, where the genetic development of this feeling is traced. Tentatively, it may be said that if animal jealousy cannot be reduced to anger and fear, it at least contains these as prominent elements. In the most rudimentary form jealousy is almost indistinguishable from pugnacious anger. In the more developed type represented by the dog who cries, whose whole demeanor is one of depression, we are at the other pole,—anger has given way to fear, which is one of the most depressive of feelings. If fear is made to include not only terror and timidity, but also the feeling of helplessness, and the sense of loss or defeat, it proves a still more useful principle of explanation; and the expressive movements manifested in depressive jealousy become thereby more comprehen-

sible. They may then be interpreted as remnants of what were once utility reactions. Slinking, hiding, retreating and sulking represent the fleeing to safety from a feared or victorious rival; crouching is a sign of submission; the drawing in of ears and tail was once a highly serviceable attitude when in danger of tooth and nail; whining and howling are the language cry of distress; while the restless and askant eyes, so characteristic of jealousy even in man, are reminiscent of the furtive, hurried glances at a pursuing or prowling foe. There are border line cases where the askant eyes bespeak anger rather than fear, where, by his nervous, embarrassed behavior, the dog seems hardly to know whether to fly at or from his rival. Which again goes to show that we are dealing with a plastic anger-fear psychosis.

However complex, in its higher states, human jealousy may be, it will always be found to bear 'the stamp of its lowly origin;' and will become more comprehensible in the light of its pedigree. It is significant that in the prehuman jealousy just surveyed, there are revealed the same two large types which the emotion assumes in man: the excited and the depressive,—'the jealousy which is angry and the jealousy which suffers.'

II. The Psychology of Human Jealousy.

There seems to be something uninviting or sinister about the theme of jealousy. Stanley in his comprehensive 400 pages on the Evolutionary Psychology of Feeling does not so much as mention the word jealousy. Ribot deplores the scanty literature on the subject, but himself devotes only a few sentences to it in his book on the emotions. James dismisses it with the one line namely, "Jealousy is unquestionably an instinct." Even Darwin has little to say on the matter. While anger and fear have received considerable treatment jealousy does not even have a monograph. Yet this feeling is both biologically and psychologically interesting, and is laden with practical importance for criminology, sociology, and even pedagogy.

A questionnaire was issued last year by the writer for securing certain data upon which to build some genetic and psychological interpretation of the subject. The syllabus follows:

A. *The rôle which envy and jealousy have played in your life.* Give a running account based on retrospection and the testimony of your parents, describing the manifestations of envy and jealousy in (1) Infancy, (2) Childhood, (3) Adolescence. Make a full list of the things which have prompted your envy or jealousy (not omitting the most trivial) and then select a few specimen cases for frank exposition. Tell at what age outbreaks first appeared, when most frequent and intense, how long they lasted, how they felt, how they were appeased, what actions they led to, etc. Have you ever felt envious or jealous

of the opposite sex, or of persons in literature or history? How do you feel toward a person whom you know to be jealous of you?

B. *Envy and jealousy as observed in others.* Describe mean, malicious things done by infants, children or youth from jealousy (such as destruction of toys, snatching sweetmeats, slapping, spitting, injuring clothes, disfigurements, lying accusations, etc.). A detailed description of some striking incident will be especially valuable. Describe also, if noticed, less aggressive manifestations like sulking, crying, hiding, etc. Mention the occasion for the jealousy, the approximate age, and the sex in each case. In the absence of overt acts are you able to detect envy or jealousy? How?

Give cases of 'class jealousy' which you have seen between groups of children (wards, neighborhoods, streets, clubs, etc.), between churches, societies, business or other corporations, cities, families, etc.

Add, if possible, observations of 'jealousy' in lower animals, stating sex, circumstances, outward expression, actions prompted, etc.

C. *An introspective description of the state of jealousy as you now know it.* Tell exactly how you feel (which, if any, of the following feelings are present: anger, anxiety, grief, rancor, self pity, fear, mortification, desire to injure). Tell how the attack comes on (slowly or suddenly); when most likely to occur; how long it lasts; whether the same attack recurs often; what impulses, what thoughts inspired. Describe all outward or inward expression, *if any* (flushing, paling, chill, sweating, changes in muscle tension, scowling, grinding of teeth, movements of eyes and tongue, clenching of fists, attitudes of body, stamping, etc.). How do you feel after an attack? Do you exercise any means of control, and with what success?

In what respects was the state of jealousy different when you were a child?

If you make a distinction and find noteworthy differences between the state of jealousy and that of envy please state same.

D. *A description of the 'jealous temperament.'* Delineate an individual who is distinctly of a jealous disposition. Tell the nature of the jealousy, and note whether the person is otherwise selfish, genial, generous, irritable, sluggish, melancholic, energetic. Specify age, sex, nationality, and any pertinent facts of heredity.

The syllabus was by no means a popular one, but 345 persons kindly responded, most of them with satisfactory frankness. The bulk of these replies came from young women students of the New Paltz, N. Y., and Trenton, N. J., normal schools, and from advanced students of both sexes in Northwestern University, Evanston, Ill. Madame Anna Grudzinska, of Kieb, Russia, sent a valuable communication accompanied by excellent replies from ten Polish men and women (average age over 30, and mostly married). Post graduate students from Clark and Columbia Univefsities also responded. In addition to the reminiscent and introspective accounts, 450 observations on children, youth and adults were collected, so that in all over 1,000 cases were available for our study.

Infant Jealousy (*from birth to six years of age*). Having considered the animal aspects of the subject in a previous section, and reserving the treatment of jealousy in primitive races for a later section, the topic next in natural order is

infant jealousy. Phyletically, we found jealousy to be very fundamental. What are the time and manner of its first manifestations in the development of the individual?

St. Augustine says, "I have seen an infant jealous; though still unable to speak, it already regarded with pale countenance and angry eyes the child at the breast with it." Quoting Tracy, "The child of three months shows by various signs a proprietary interest in the breast, handles it as his own, and is jealous if it be given to another. Later he demands it with still more authority." "At three and a half months, little Mary is jealous in the extreme and cries if her sister sits upon the mother's lap." "From the eighth month, another child gave every evidence of jealousy in similar circumstances, grew angry and tried to drive the usurper away."

Mr. A. Stevenson, contributing to *Science* (Oct. 28, 1892), reports a clear case in his little girl aged only ten months. "Her brother (age four) has just returned after an absence. She displays great affection for him, but is also much attached to her nurse. If the nurse takes up the boy and fondles him she "will immediately cry out in a distressful way, in a tone not precisely indicative of anger or vexation, but more nearly similar to the tone of grief or disappointed desire. In the case described the infant will not be appeased unless the nurse puts down the boy and takes her up. It will not avail for the nurse to take her up on one knee, leaving the boy on the other."

Sikorsky places jealousy which manifests itself in rage in the first year of life. (78, p. 56.) Perez mentions a child of 15 months who was jealous if sugar was given to its nurse, and another of the same age who enacted curious little scenes of separation, scolding, and pushing when her father tried to kiss her mother. (32, p. 71.) Tiedemann's son (age 22 months) showed signs of displeasure on the birth of his little sister, whom he tried to beat whenever he saw her on his mother's lap or in his own cot. Darwin noted plenty of jealousy in his child at 15½ months, and observes that it can probably be found earlier.

Dr. May S. Holmes, Supt. of Isolation Hospital, Worcester, Mass., had ample opportunity to observe the jealousy of a little patient who had been under her care for over a year. The case is reported below in condensed form:

Yetta, girl, four years of age, Jewish parentage; normally developed, fair; fine, red, curly hair; very bright, attractive child, except when in a temper; inordinately vain and coquettish; not very affectionate, but very insistent in her demands for attention. Y. entered the hospital almost moribund with diphtheria; paralysis of the larynx necessitated the wearing of an intubation tube and she has acquired the tube habit. The state of her health decidedly affects her irritability. There are four ways in which the jealousy expresses itself: (1) trying to attract attention from a rival by coaxing, taking hand and leading away; (2) by sulking, (3) by passing from sulks into a stiffened pose, with body thrown into a most uncomfortable position, eyes staring and usually turned down to the side. Y. was seen to keep such a position one day for half an hour because of some attention to another patient. She gets very much flushed and is sometimes not good natured again for some hours. (4) By a paroxysm in

which she will do herself bodily harm, principally in scratching her cheek and tearing her hair. "This morning," writes Dr. Holmes, "I found her just passing the climax of such an attack. She had torn hair out of her head, so that the nurse could hand me some; pieces of hair were all over her face, hands, and dress; she lay with her hands across her face attempting to cry, but as the tube prevents any voice, she could only make a loud blowing noise. She was badly cyanosed and the pulse was 164. . . . Her eyes are always set staring, never rolled up. Sometimes she has thrown herself onto the floor from her bed."

Besides many reminiscent accounts, the questionnaire returns furnished (objective) observations of 103 cases of infant jealousy, definitely reporting the age, sex, and circumstances. These cases (52 boys, 51 girls) fell into two almost equal classes: (a) jealousy shown in regard to concrete things, possessions, etc., (b) in regard to attentions, caresses, etc. This distinction, however, is not always possible, nor very useful. Playthings figure prominently. They are smashed and torn to pieces often enough and decisively enough to bring delight to the heart of any manufacturer of toys who might read the returns. Sometimes, however, the toys are only snatched or vindictively guarded, or taken away and hid.

B 2 would not allow his sister even to touch his toys. B 5 screams and cries almost beyond control if a toy is taken by his brother. B 4 will hide his best playthings when G 3 comes to play with him. G 5 vigorously refused to allow any one to wheel her baby brother in his 'pram,' though refusing herself to do so. One of twin boys nine month old will snatch his brother's bottle, drink the milk and then hit him with the empty bottle.

The tyranny of infants in regard to attentions often becomes amusing. G 5 would not allow any one to read in her presence, *i. e.*, would not permit any one to attend to a book instead of to her. G 3 opposed any one who tried to kiss her mother. Another child of three hid behind a chair when dispossessed from mother's lap. B 3 crawls into his mother's lap when any one shows affection for her. Infants will struggle and fight to be the only one in father's lap, and boast that they are best loved by him. B 3½ slapped a lady visitor because she swung other children besides him in the swing. He could not be made to understand what it is to play by turns.

Infants will variously hold out their arms, fret, whine or burst into violent crying, cover their face with their hands or sulk when their mothers caress or hold another baby. G 3 is so jealous of her mother's petting she will on occasion roll on the floor, scream, kick and bite like a little beast. G 4 tried to pull her rival (six months of age) from her grandmother's arms. She also hit the baby when asleep. It is dangerous to allow them together alone. G 5 tried to shake her new-born baby brother. G 4 struck her baby sister with a whip. G 2½ tried to pluck the eyes out of her baby brother. She had to be carefully watched. B 2 pretended to want to kiss a baby three days old, but brought out an iron rod to strike it. He showed joy when the baby died. B 5 had to be taken from home on the birth of his sister. He threatened to kill her.

A rival in the shape of a new-born baby brother or sister is one of the most frequently mentioned causes for early and vio-

lent outbreaks of jealousy. The manifestations are very pronounced and they seem to be especially instinctive in origin. They constitute, sometimes, the most precocious of juvenile murders. And, to look at things from the child's standpoint, the provocation is great. After an uninterrupted and absolute reign, to take a little monarch by the hand, and with mysterious mien to usher him into the birth chamber, and ask him to felicitate on the arrival of that ugly looking little pink mass, there on the bed, robbing him of his accustomed caresses,—that is asking too much. And the scenes which are enacted on these occasions are not without their pathos and tragedy.

B 2½ showed a contorted mask of pain, spiritual discomfort, and almost despair on the birth of his brother. G 5 cried, 'Take him away. She is not his mama, but all mine.' B 4 showed jealousy for a whole month after the birth of his baby sister; refused to leave his mother and had to be forced out of the room; would not play; would not allow any one to touch him in these spells, but cried continuously, "I want mama, I want mama!"

Helen Keller in her autobiography makes the following confession: "For a long time I regarded my little sister as an intruder. I knew that I had ceased to be my mother's only darling, and the thought filled me with jealousy. She sat in my mother's lap constantly, where I used to sit, and seemed to take up all her time and care. . . . At that time I had a much-petted, much-abused doll. . . . I had dolls which talked and cried and opened and shut their eyes, yet I never loved one of them as I loved poor Nancy. She had a cradle and I often spent an hour or more rocking her. I guarded each doll and cradle with the most jealous care; but once I discovered my little sister sleeping peacefully in the cradle. At this presumption on the part of one to whom as yet no tie of love bound me, I grew angry. I rushed upon the cradle and overturned it, and the baby might have been killed had not my mother caught her as she fell." (26, p. 15.)

Dolls are in the same category as persons at this and a later period. One, G 2, exhibited jealousy when her doll was petted by her mother, and threw the doll on the floor in a fit of anger. Moreover, as Ellis and Hall found, in 77 of 579 cases, jealousy was one of the psychic qualities which children attribute to their dolls.

Though even infants may cry in secret from jealousy, it is evident from the examples above that their feelings are usually promptly and plainly expressed. Those cases in which the jealousy is formulated in words are especially interesting and convincing.

G 3 on seeing her mother pet another child exclaimed, 'Bad boy mama. My mama.' G 1½ when mother took up her baby brother said, 'Let him cry. Take me.' B 2½ having smashed a rival's toy, said, 'Now I guess you won't play with it.' B 5 joyfully greeted the announcement of his little brother's illness with, 'Now I can have both chairs!' G 4 after her father had carried her brother "piggy back" said, 'I wish I could poison Thomas, I hate him so.' Another little girl, when her mother petted some one else, sobbed, 'All my

mama, all my mama,' and would be comforted only when assured that mother was all hers. B 2 clung to his mother on the coming of a baby visitor and could not be coaxed to play. Very seriously he asked, 'What baby is that? Is it coming again?' B 3 when invited to his playmate's party was woefully surprised to see so many present, and staunchly said, 'I don't want other boys around when I go to see Janet.' No mention of ice cream or games could induce him to join the party. G 3 on seeing her lady friend, Miss M., walking with another little girl, said, 'I hate Miss M. I'll kill that little girl that is with her.'

Childhood Jealousy. (*Age, six to twelve.*) This is the elementary school age. The social interests widen, and the sense of self develops correspondingly. Competition, leadership and organization become important features in the plays and games; and the child's whole environment grows complex. The jealousies though still childish are less so than in the previous period; the self takes on, to a higher degree, the character of a socius and becomes more sensitive to fine distinctions. The situations which excite to jealousy are less egregious and often involve only the slightest partialities, or even imaginary differences in favors, gifts, clothes, etc. Let any one attempt to distribute Christmas dolls in the children's ward of a hospital, without taking the precaution to dress all the doll's alike, and he will see what is meant.

As the social sense grows keener, the tendency of rivalry increases. This is the period of boasting and of showing off. The writer examined 105 questionnaire returns on the subject of bragging and taking a dare, and found that these egotistic tendencies in children are by no means purely egocentric, but are colored by a strong social appreciation, and a spirit of competition. The common expression of these boasts is, 'Mine is nicer than yours.' 'Mine is bigger than yours.' 'My pa can lick your pa.' 'My gang can put it over your gang.' A gentleman tells G 6 what a big dog he has at home, and she, not to be outdone, says, 'O, that 's nothing, I have a dog at home as big as this room, and with a head as large as the piano.' B 8 heard his teacher say that a certain girl could read better than he. After school he came up to her and said, 'If you can read better, I can fight better,' slapped her and ran away. Many more instances might be cited to show that it is a social setting which brings out the dare and the boast. The comparative instead of the merely individualistic manner of statement, shows that a spirit of rivalry is behind them, a desire not to be outdone, something akin to jealous self-regard. Hall and Smith in their study on Showing Off say that, "In bragging lies, in regard to possession, envy and imitation are frequent motives." (20, p. 16.) The delight in exciting envy, also, is one of the motives of children's teasing, while

precociously coy little maidens like to excite jealousy in their lovers by being nicer to other boys.

Indeed, this is the age when most of the cases of pre-adolescent affection appear, bringing forth a type of jealousy much more highly developed than anything in the earlier period. "Jealousy is present from the first," says Bell. "It is more pronounced in the cases of love between children and adults of the opposite sex, on account of the child's being less able to monopolize the attention of the adult and on account of the precocity of the child concerned in such cases." (5, p. 335.) These youngster lovers are watchful, exacting, hostile toward rivals, heartbroken at slights, and even romantic, as is abundantly proved by the following extract from a letter by a boy of twelve to his sweetheart of eleven:

G. and N. B. liked to scare me to death and I started to cry. I thought for a while you and Floyd had up a case. But he can't cut me out, can he, Hildegarde, dear? He is jealous, but he can't have you, can he? Floyd makes me tired with his songs and sayings. But do not get mad at me, for I am not mad at you. You and Floyd are not going to get up a case, are you, dear? For I love you, and I think you love me, don't you dear? It makes me mad to see you laughing and smiling at each other. So don't get mad at me, and just tell Floyd you are not going to have anything to do with him.

This is, also, the period of heightened clothes consciousness, and sensitiveness to inequality in dress, which causes many malicious acts traceable to nothing but envy and jealousy. Both boys and girls, as our returns show, attack each others' clothes by cutting holes in them, throwing mud, or spilling ink on them.

G 6 hid when her sister had a new dress. Another girl led her playmate, who had on patent leather shoes, into a mortar bed. B 11 cut a belt from another boy's coat because he had no belt on his. B 9 cut a slit in his brother's nicer coat. G 11 will stay indoors in the nicest weather, if a visiting playmate is better dressed, and makes bitter remarks from jealousy. G 10 soiled the apron of another girl, and when asked why she did so, replied, 'Because I never had a nice apron.' The spirit of boast and display in boys with new caps and girls with new sashes helps to excite this childhood jealousy to its malicious deeds of mutilations and soiling.

The school life with its examination marks and craving for the teacher's favor gives much opportunity for the exhibition of jealousy. This is the age when tender-hearted girls, especially, become very sensitive to criticism and will weep bitterly if in their fancy another has displaced them or outranks them in the teacher's favor. It is for many one of the keener sorrows of childhood, this inability to secure the predominant if not exclusive love of the teacher. The recognized necessity of observing very strict impartiality in school government indicates that the latent spirit of jealousy is strong.

G 10 marked up her rival's note book on account of the praise which the latter received from her teacher. B 6 slapped a schoolmate 'Cause he always knows his spelling and gets a hundred every day.' G 6 if she is excelled in writing is enraged by her jealousy; will try to sponge out the work of others, to scratch them; and will lie down in the grass and kick and cry because she cannot jump as high as her mates. G 8 will sulk, act stubbornly, will not listen to the story lesson, if she cannot sit next to her teacher in Sunday school.

The type of jealousy experienced by different children, varies not only with their age but with their temperament. Some manifestations show a refinement of feeling which is almost precocious, others are infantile in their crudeness. The few following examples will speak for themselves:

G 8 when washing dishes washed her own cup before her sister's; she wished to stand first; it was an action merely symbolic of her thoughts.

G 10 (reminiscence of college woman). My first experience of jealousy, which made a vivid impression, so that the memory is perfectly distinct after many years, came in connection with an illness of my mother who was my childhood idol. . . . My jealousy was because these kind neighbors insisted on doing things for mother (I wanted to be the sole nurse), and I shall never forget my intense anger at them, nor my fits of passionate crying whenever one of the neighbors replaced me in the sick room. This occurred whenever mother was sick for several years; and I was a girl of 15 or 16 before I succeeded in mastering these jealous feelings.

Dr. Caroline A. Osborne carefully observed for a long period two interesting cases of jealousy in the children's ward of the Worcester Memorial Hospital, and kindly furnished the facts set forth below.

Alice, a beautiful little French girl, having drunk caustic lye, was brought to the hospital at about the age of five, and remained for several years. Both from a medical and a psychological standpoint she was an interesting patient. She had to be fed by a stomach tube, and was much below normal size on account of limited nutrition. Because of her beauty, her diminutive size, and her winning, flirting ways, she was the favorite for the attention of visitors. She had a veritable greed for such attention, and posted herself where she would be most likely to see the largest number of people. A typical child in most other respects, she was precocious in the over-development of a calculating acquisitiveness, which expressed itself particularly in the direction of food. This insatiable hunger, especially for candy, may have been the physiological outcry of a starved system, but it was also a psychological fact. Exceedingly observant and retentive of the minutest details bearing on the great question of food supply, and without a moral sense to abash her, she regularly diverted so far as lay in her power, the generosity of nurses and visitors from others to herself. Her jealousy was surely describable by Lombroso's terms, as "a tyrannical desire to monopolize." It was not a jealousy which expressed itself either in grief or anger, but rather in a cold, vigilant Machiavellianism, which seemed uncanny in so small a child.

Mary Jane, an Irish girl of ten, on crutches from hip disease, was another patient in the same ward. She was of a different stamp from

Alice; overgrown, rather than undersized, appealing to one's pity rather than admiration. Her jealousy also was of a different stamp, and showed itself in outward signs, while Alice's was concealed. It was a common sight to see her standing off to one side, watching with wistful, askant eyes, the attention which the other patients, particularly Alice, so disproportionately enjoyed. This watchfulness was written in the expression of the eyes, her scorn in a drawn mouth with corners turned down. Resentment and a questioning inability to comprehend the situation were also present in this frequent 'jealous look,' as the nurse called it. That it was a real case of jealousy was pretty clearly proved one day, when the nurses, suddenly aroused by a noise, rushed to a scene of commotion in the bathroom. What should it be, but Mary Jane braced on her crutches, vigorously trouncing the diminutive Alice, — and why? Mary Jane explained in a tearful voice, "Because she is so pretty and they give her things all the time!"

Not counting reminiscences, our returns report 151 cases of childhood jealousy, stating age, sex, and cause. The facts which come out most strikingly in these cases (64 boys, 87 girls), when compared with those for the infancy period, are the greater diversity and refinement of the exciting causes, and of the manner of expression. Fully 80% of the infant cases were expressed in fundamental, and what might be called racial ways, — by stamping, screaming, biting, striking, etc. Such manifestations, although they are by no means absent in children from six to twelve, are often displaced by expressions of a psychologically higher order, like sulking, lying, mocking, slandering. Threats of murder and drastically disastrous wishes against rivals may be openly or secretly held, but instead of overt aggression, we frequently find children sulking, brooding, withdrawing into themselves, and hiding sometimes for hours. There are real cases of wounded affection and of bitter, non-petulant weeping for one thing. Tattling also becomes a prominent manifestation. This tattling is a species of contempt, a kind of disparagement, comparable to the more scientific gossip of adults, and children take a corresponding delight in it; because they feel that to lower the reputation of a schoolmate is to increase their own. Again, jealousy comes to be a prolific source of children's lies; tattling itself is often sheer lying accusation. 'Ferriani personally studied 500 condemned juveniles with reference to their lying habits, and found that 195 lied from jealousy, envy, and revenge.' (19, Vol. 1, p. 352.)

Adolescent Jealousy. Eighty-two cases of a reminiscent character, stating age and circumstances, were given. Of these, 50 speak of talents, class-marks, beauty, popularity, etc.; 32 of attentions to friends, lovers, etc., as being the cause for jealousy. The returns show a marked change over the childhood period. And this we should expect, knowing that psychic adolescence is heralded by 'all-sided mobilization,'

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that 'the consciousness of childhood is now molted,' that a special consciousness of sex now dawns, that hero worship and a longing to excel arise. "Self-feeling is increased," writes Dr. Hall, "and we have all forms of self-affirmation. The new sense of self may be so exquisitely delicate that a hundred things in the environment that would never rankle before, now sting and irritate." (19, Vol. 2, p. 79.) Mere possessions having only a personal value, are no longer causes of jealousy, and if clothes are mentioned it is rather because of their importance in the eyes of others, for the ego now is much more of a socius and keeps at least one eye on the *alter* of society or the opposite sex. Youth desires fine clothes, talents, advantages, for their impressiveness upon an onlooking world. Thus at the adolescent stage the returns mention as excitants to envy or jealousy such things as talent in music, popularity in athletics, brown eyes, girls with long, thick hair, elocutionary ability, a pretty face, self-confidence and powers in conversation, capacity to think quickly, good vocabulary, pleasing, graceful manner, cleverness, skill in making witty remarks. Is it not significant that the more purely personal qualities such as modesty, cleanliness, sincerity, are never mentioned as causes of envy or jealousy? This is the romantic period, when girls especially magnify their own deficiencies and their own possibilities and revel in the mere delight of being a French countess, a colonial dame, a Southern belle, George Eliot, Evangeline, or Joan of Arc. The intense longing to be a great actress, to be a world favorite musician or artist often verges on the morbid, and is then more akin to envy, than to simple, normal desire. An almost constant craving for sympathy and recognition, a new sense of self-importance, and by Hall's law of emotional antithesis, a tendency to pass to the other extreme of self distrust, make adolescence a productive season for rank growths of envy and jealousy.

Youth sometimes appears to be as tyrannical in regard to attentions as infancy, but slights wound in a deeper and peculiar way.

G 17 cried bitterly because her sister entertained a gentleman friend to her seeming neglect. G 13 was hardly civil when her father showed hospitality to a girl visitor of about her age. When the visitor had gone she made her father tell her over and over that he loved her best. G 20 cried a half hour when her sister received a new hat from her mother, thinking it a sign of preference on the mother's part. G 12 threatened to kill herself because of the greater attention she considered was shown to her brother.

If anything, there is more exaction in regard to the attentions of friends outside the home. This comes to light in the crushes and mashes which are now so common. Girls 'chum

it' with much intensity, and often live in constant trepidation lest their friend show more preference for another, and ask time and time again to be assured that they are the first and most dearly beloved. This comes out prominently in the returns. Girls are 'terribly' slighted if not told a secret, or a piece of news first, or are not invited first, etc.

G 19 says, "I want my friend all to myself." G 20: "I want my friends near and want to monopolize them." G 16: "I saw a girl with her arm around my chum, and I was so jealous I went up stairs to have a cry." G 18: "I feared lest my friend should love another more, though she constantly tells me she loves me better than any other person." Many of the quarrels and fallings out in these crushes have jealousy at the bottom.

Most intense, however, is the jealousy which accompanies adolescent love-making. Girls like to provoke it in their beaus and play with it, though they are by no means free from it themselves and are fearful when a supposed rival appears with a new trinket, ornament, or a new dress calculated to attract more attention. Two cases are reported below; further examples may be found in Dr. T. L. Smith's article on Types of Adolescent Affection.

M 28. "I had a desperate siege of love jealousy in my high school years. I aimed to look unconcerned before my rival, but tried to get my girl's sympathy by catching her eye, looking grieved or hurt, and simulating a nervous tremble while I wrote. No matter where they sat I kept my eye on them closely; would grind my teeth and utter threats under my breath. The jealousy was a kind of chronic obsession; but was intensified by a concrete situation which I could take in directly with my eyes, when I felt enraged enough to chop off my rival's head. I never planned to poison him, but wished him all manner of evil, and if the circumstances had been right, I might have done something serious. I brooded and would lie awake nights to roll my pain like a morsel. I planned to ruin my rival in the girl's eyes, and contrived to get a blank marriage certificate which I filled out with his name and hers, counterfeiting my rival's handwriting; but was restrained from putting it on her desk by a sense that it was a contemptible trick. One time I caught him when he put his arm around her — I could have killed him on the spot."

The following are extracts from the Journal of Marie Bashkirsteff. (3.) As early as page 2, when she was 12 years old, she says:

I love the Duke of H. Mar. 14. I should be so happy if the Duke would only take notice of me, and I would bless God. Oct. 13. I was looking up my lesson to-day when little Herder, my English governess, said to me, 'Do you know that the Duke is going to marry the Duchess M—?' I put the book closer to my face, for I was as red as fire. I felt as if a sharp knife had pierced my heart. I began to tremble so violently that I could scarcely hold the volume. I was afraid I was going to faint, but the book saved me. I said my lesson in a voice that trembled with emotion . . . . but what passed within me, in the depths of my soul, no one shall ever know! Oct. 17. I read the announcement mention in the newspaper. . . . I could not

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write in the evening. I threw myself on my knees and wept. (Inserted note: Reading this seven years after produces no effect on me whatever). Oh, I detest him! I want to see them together. . . . How I am changed since the 13th of October, that fatal day! Suffering is depicted on my countenance. His name is no longer the source of beneficent warmth. It is fire; it is a reproach to me; it wakens jealousy and grief within me. Nov. 29. I am tortured by jealousy, love, envy, deceit, wounded vanity, by every hideous feeling in the world.

There can be no doubt that at adolescence the feeling of jealousy rises to a higher plane. Ninety persons definitely answered the question, In what respects was the state of jealousy different when you were a child? With few exceptions, the judgment is that childhood jealousy is more explosive, violent, shorter, more sudden, objective, frank, and is prompted by pettier and more material causes. Following are some of the differences noted in the returns. In childhood it was 'unreasonable,' 'more like a summer shower; now it is a winter's gloomy storm.' 'The attacks were brief, soon forgotten, and did not fatigue so much.' 'In childhood bitterness was felt toward the person, now it is toward the self.' 'As a child there was only egoism in the feeling, now there is none.' 'The signs were more outward, now they are more inward.'

The latter distinction is valid for a good many cases. The typical expression for childish jealousy is violent, overt, anger or aggression; but in adolescence, under the whip of jealousy, the feelings may become painfully subjective; the soul turns in upon itself, broods, grieves. Lancaster found that the curve of despondency beginning at eleven rises steadily and rapidly till 15, and culminates at 17. (19, p. 77.) Only animals high in the scale can experience the depressive type of jealousy, which even in the human first comes to its fuller development as late as adolescence.

Adult Jealousy. Proceeding now to adult jealousy, we are at once confronted with the immensity of the subject and the impossibility of surveying it. The writer, at least, believes that jealousy is an almost universal instinct determining action in a multitude of ways, if not always as a conscious motive, nevertheless pervading the ins and outs of little things and great, from the peanut stand to a continental railway system, from a sewing circle to the Congress of Vienna. The causes and circumstances are too numerous and diverse to invite classification, but it is certain that the instinct of jealousy, however lowly its origin, is not a transitory affair peculiar to infants, children and youth, and that it persists into old age, even after the battle of life has been lost and won. With comparatively few exceptions, in neutral or rare individuals, it is present or

latent in all human beings,[1] and colors the struggle for existence in the smallest as well as the largest of its aspects.

Examples of adult jealousy are known to every observer of human nature, yet the citation of a few selected (non-criminal) cases may serve a purpose.

F — idolizes her son, and is extremely jealous of all his friends. Reads all his letters that she can get hold of. When he became engaged to be married, she became ill over it. Though the girl was an estimable one in every way, she persisted in saying contemptible things about her future daughter-in-law.

F 31. I detest now when somebody kisses or fondles my children, and when they cling to friends or relatives; even their devoted love to their father at times grieves my heart.

F 35. I was exceedingly jealous when in love; and tortured the man so that he was quite unhappy. Once married I did not feel jealousy any more. I liked to see him young and charming, and hear how ladies favored him. I often heard the nonsenical question, 'You are not jealous? And you have such a beautiful husband!' I think people and the world often inflame this bad feeling. In later years I often felt envious of wealth, the world's goods and fortune, and wished the worst things to happen to our happier neighbors. The feeling passed with the first stroke of good fortune.

F 23 is a tyrant to her husband, who does not dare to go out without her, to look up or say a word about a woman. She dismissed all the women servants and causes a row about every day. Her jealousy is a veritable madness; her body becomes rigid and she is seized with cramps. Possibly it will pass when she becomes a mother.

F 27. When I was grown up I loved to tease the men who courted for my hand; it was a very agreeable thing to do, and I felt never a moment's remorse. Maybe, it was due to the influence of my old nurse, who always recommended me to torment gentlemen, 'for they are like dogs, — nothing can harm them.' She sang a couplet to this effect, and I thoroughly believed her. I am a jealous wife, I know. I never allow pretty girls to come near, have old servants, and a superannuated nurse for my boy, and she sees to it that I have no cause for suspicion. Now since I have the baby, I am less jealous of my husband, yet I cannot say I am altogether free from this feeling.

M 30. I feel envious in my career now and cannot bear that one speaks about other physicians as able and renowned; it makes me sick at heart.

F 35 is a beautiful and much admired woman, but so jealous that her husband doesn't even dare to go anywhere accompanied by her, because she is sure to make a scene. She hates all women, especially girls. She was also a very jealous child, as her mother says, and had convulsions which occurred every time she had a fit of jealousy. She is consumptive now and we have all observed that since this illness, she is less jealous and even likes it when her husband goes to

[1] It is, of course, impossible to get any satisfactory data as to the universality of jealousy. Only 26 out of the 346 answering our questionnaire disclaimed having jealousy in their composition. Two hundred and thirty persons replied to the question, How do you feel toward a person whom you know to be jealous of you? Again only 26 replied that they had never known any one to be jealous of them, which is another interesting sidelight, showing the prevalence of jealousy.

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see her friends; and now, for the first time she has taken a *young* governess into the house. The others had always been 'monsters,' or gentlemen.

F 40 is so jealous that she never allows her children even to embrace her grandparents. One time when her little boy of six years let it out that he had been to his grandmother's and gotten some candy from her, she gave him such a slap in the face that the child actually lost consciousness.

M 28. When in college I became passionately attached to my roommate, in fact I loved him. I did not want him to marry, and I planned a home in which he was to live as one of the family, my wife loving him almost as much as me. When, one day, a letter came announcing his marriage I felt terribly hurt—hurt is the word; it was hardly mortification, still less rage or resentment; it was keen grief, falling sensation in the stomach, pressure pain on the chest, more especially about the heart; it was a dire sense of having lost something, of being poorer. One of the hardest things I ever did in my life was to write the letter of congratulation.

M 70 (condensed delineation of a jealous Scotchman); not selfish; generous to a fault; keenly sympathetic; kind hearted, genial when things go well; quick tempered, rather irritable, very energetic, impulsive, almost fiercely enthusiastic; easily carried away by an idea; very vain especially of newspaper notice, public recognition, and even personal appearance as photo; inclined to magnify his office; very sensitive to interference by colleagues; jealous of new enterprises undertaken by them that had not occurred to him, and well satisfied if such undertakings miscarry; determined to 'get in' if success is probable. This trait is most marked. Very jealous in social matters and of authority and property rights; sensitive to lack of respect by inferiors; has remarkably graceful way of covering chagrin when worsted.

This last description is quoted as a good example of one kind of jealous temperament; and to bring out the fact that jealousy is not limited to morose and sinister individuals. In fact, so far as our results go, it is not associated with any distinctive type, and may appear in many strange combinations. In our returns there were described 185 'jealous temperaments.' Of these, 88 were also mentioned as being selfish, 87 as irritable, 61 as energetic, 56 as genial, 54 as generous, 43 as melancholic, 26 as sluggish. Irritability, selfishness and energy seem, therefore, to be the most frequent correlates; but not by any means necessary ones. The influence of heredity is often mentioned, but not with sufficient surety and uniformity to warrant any conclusions.[1]

[1] Dr. G. E. Partridge kindly loaned me some statistical data on temperamental qualities of school children of elementary grade. By underlining a number of adjectives or descriptive phrases, printed on child study outline blanks, teachers were able after a year's study to delineate rather fully the character of the pupils under their charge. Out of a total of 1,094 delineations, only 19 (10 girls, 9 boys, ages 7-16) were reported as jealous. Of these 19, 10 were good natured, 11 disagreeable, 9 sensitive, 6 generous, 12 complaining. The smallness of the number reported as jealous can be accounted for by several reasons, which need not, however, to be here considered.

Madame Anna Grudzinska thinks that poets and artists are very often jealous of rivals, of their fame, riches, wives, and their own inspirations. She cites Julius Slowacki (see his *Letters*), Adam Mickiewicz, and Chopin as examples among Poland's eminent men. Victor Hugo and Molière were known to be jealous, and Heine went so far as to poison a poor parrot of whom his Mathilda was fond. Wharton in his Life of Pope, observes, "Among authors, jealousy and envy are incurable diseases." Finck thinks that men of genius, owing to their high emotionality, are usually very jealous. (16, p. 129.)

Jealousy Distinguished from Related States. Anger and fear are so original, so underived that it is almost impossible to define them psychologically except in terms of themselves. This is not true to the same degree of jealousy; for the state of jealousy, it will be found, is a compound or aggregate, and permits of considerable analysis in terms of other feelings. The present phase of our subject will be approached by a descriptive definition of jealousy and allied emotions; the distinctions made will, however, be logical rather than psychological in purpose.

Rivalry is a broad, protean term used by both biologists and psychologists. For Baldwin, it is a complex having the following ingredients: biological struggle for existence, desire of being a cause, love of power, love of the game itself, self-assertion, imitation.

Competition may be made to apply to rather definite cases under rivalry, when the object striven after is more or less clearly in view. (Century.) Both are species of self-emphasis and assertion of power, which are the prerequisite of jealousy, emulation and envy.

Many and various attempts have been made to define *jealousy:* 'Suspicion or bitter resentment at successful rivalry' (Century). 'Apprehension or suspicion of being outdone by a rival in matters of affection or favor' (Standard). 'Aversion to the winner who carries off the trophy of his superiority' (Martineau). Ribot accepts Descartes's definition, 'Jealousy is a kind of fear related to the desire we have of keeping some possession.' By distinguishing jealousy from allied states, its exact meaning becomes clearer. *Emulation*, for instance, may be taken to signify an expression of love of power and superiority for their own sake, but 'being intrinsically neutral as to time and motive.' It is the pure desire to raise oneself to a superior state, best typified in Wordsworth's Happy Warrior of Delight 'whose high endeavors are an inward light.' *Envy*, 'however, designates a more sinister state which contains the pain of inferiority, irritation and a large amount of ill feeling toward the individual who affects us disagreeably by the mere

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fact of his superiority.' (23, p. 90.) Jealousy is differentiated from envy by the absence of the consciousness of inferiority. As Martineau puts it, envy is 'the grudging sense of relative inferiority.' Aristotle makes a neat distinction. For him, envy is a feeling of pain, *solely* because *others* are prosperous. Emulation is also a species of pain, but solely because *we* are not so prosperous. The former is vicious, being satisfied with a leveling down; emulation is virtuous, and only satisfied with a leveling up. 'Envy to which the ignoble mind's a slave, is emulation to the learned and the brave.'

What are the opposites of envy and jealousy? Spinoza figured out 'that the nature of man is generally constituted so as to pity those who are in adversity and envy those who are in prosperity.' 'Envy is hatred in so far as it affects a man so that he is sad at the good fortune of another person and is glad when evil happens to him.' 'Compassion is love in so far as it affects a man so that he is glad at the prosperity of another person and is sad when any evil happens to him.'

Horwicz discusses this interesting contrast in a lively section of his *Analysen* entitled *Mit- und Fremdgefühle.* (21, pp. 302-325.) 'In a certain sense,' he thinks, 'it may be said that envy is just as natural for the heart of man as is sympathy,' but he adds, 'it is much more difficult to rejoice with the joyful than to be sad with the sad.' 'There are some natures so noble that they can see another in possession of a good for which they have ardently longed, not only without envy, but with actual *Mitfreude.*' Nevertheless, Horwicz finds so much *Schadenfreude* and *Missgunst* that he is prompted to exclaim, 'Do we really harbor in our breast, beside the good, a bad spirit, a devil beside the angel? Is there a purely disinterested joy in disaster itself? Alas, we cannot entirely absolve human nature from the charge.' *Mitfreude* is an academic word rarely used by Germans. Is this a commentary on human nature? Why is it that our own standard dictionary does not print the highly respectable word *confelicity?*

The contrast between pity and jealousy is recognized in Schopenhauer's philosophy. Jealousy, as an expression of the will to live, is a most sinister evil; while pity, which assuages that will, is the highest virtue. But Nietzsche naturally makes pity the thing most despicable. There is a proverb, Pity cureth Envy.

By way of summary, then, we may say that envy arises in a mere situation of inequality (not rivalry), and has no reference to the affection or favor of a third party, no sense of personal injury, but is simply a feeling of inferiority; while jealousy embodies all these things and involves a situation of real rivalry. But, as we shall see, it is a plastic complex, which defies the circumscription of a definition.

Expression of Jealousy. We have already stated by example and otherwise the expressive movements connected with the jealousy of children. The outward manifestations which become extreme enough to be either pathological or criminal are reserved for a later section. We have now to mention in more detail the symptoms associated with the jealousy of generally normal young men and women, as based on their introspections. Numerically these symptoms distributed themselves as follows: Flushing 73; paling 22; chill 16; sweating 26; muscle tension 44; scowling, clenching of fists, compressing of lips, gritting of teeth (one or more or all of these combined), 60. Rush of blood to the periphery and a general or partial tensing of the muscular system were most frequently mentioned. The body assumed an erect position, a rigid attitude, or moved as if in great pain. For one person the chin quivered, the lips became extremely white, the corners of the mouth were drawn. The eyes might be fixed, roll, flash or grow dull. Some would sit very still, others would stamp, crouch, or walk heavily or wring their hands. Several pressed their tongues against the roof of the mouth. Many girls like to seclude themselves or cry bitterly; one young woman claims that no other emotion can make her cry. For others jealousy is too dry a state for tears. Some fall prostrate when they weep. The general complex of symptoms accompanying sulking and obstinacy are frequently present.

Quoting Sutherland, "Dislike, jealousy and hate are, in their physiology, closely analogous to fear and grief. They whiten the skin, reduce the glandular secretions, and depress the vitality; but they have one very distinctive feature. The bodily powers which they restrain are still present though kept in repression. . . . The woman who looks like marble from the deadly gnawing of jealousy will show a deep, dark flush when her rival suddenly comes in sight." (40, p. 289.)

The fact is, as the returns abundantly show, that jealousy being an extremely mutable psychosis, presents many variations between individuals and even in the same individual. Good introspection will discern slight expressive movements in very mild cases, but often enough such movements are small if not imperceptible. Many of the correspondents said they had none whatever. Thus one young woman wrote that her 'envy and jealousy do not express themselves outwardly; they eat inside of me.' Long training and pride may succeed in hiding jealousy from the world's view; but observers of sensibility can discover it even behind a mask. The question, *In the absence of overt acts are you able to detect jealousy? How?* brought many interesting and suggestive replies. Subtle changes in the expression of the countenance

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were most often mentioned, particularly of the eyes, confirming the proverbial location of envy and jealousy in that organ. As one correspondent put it, 'Jealousy may be detected by a certain expression of the eyes, indescribable but perceptible to observant and sensitive people, an acute, watchful, anxious gaze, averted when it perceives itself watched.' Other indexes mentioned are, the manner of carrying the head, firm set mouth, restless or strained behavior, compression or movements of the lips, slight tightening of the muscles, sighing, elongation of the face, suspicious, pumping questions, over-assumed indifference, inuendo in remarks, chariness of compliments, unguarded words, drooping of corners of mouth or lack of interest shown in listening to another's praise. One young woman perceives jealousy in 'the reserve nature, the flashing eyes, often sulking look. Even where these are not seen there seems to be something in the very air which tells me of the presence of a jealous person.'

Darwin says that his correspondents generally denied that they could recognize jealousy, and thinks that envy and jealousy can hardly be considered to have any characteristic expression, and that the vague and fanciful phrases which poets use in describing these states is a confession that they have no clear outward signs. (9, p. 79, p. 262.) Sir Charles Bell attempts to describe the facial expression of jealousy more fully than Darwin (4, p. 157), but thinks that only poetry like Shakespeare's can truly portray the emotion in the vivid colors of nature, and he considers it a difficult subject for painters.

By the employment of accessories this difficulty is somewhat reduced, and artists do not altogether avoid the theme. I was able to secure two pictures in which it was present, and these I used to test whether an artist can really portray the emotions of envy and jealousy, clearly enough to be correctly interpreted, without the assistance of a suggestive title. The first of the pictures was a colored art supplement by *Geoffroy* from the French Magazine *L'Illustration* (*numéro de Noël*, 1905) entitled *L'Envie*, supposed to represent an envious little girl, intently following behind another little girl of the same age, who was fortunate enough to be the possessor of a coveted bunch of rosy cherries. The second picture was a copy of Mme. Elizabeth Gardner Bourgereau's *The Award of Paris*, which represents a barefoot boy (Paris), age about eight years, presenting an apple to the prettiest of three girls. On the right, and in the background is a girl who is supposed to be jealous. Grasping her skirt with one hand, the little finger of the other hand in her mouth, she looks upon the awarding with askant eyes. The first picture was tried upon 24 subjects, the second on 16. On the first exposure only the envious

or jealous girl was shown, the rest of the picture being covered up. On the second exposure the titles only were concealed. The reactions of the subjects were entirely spontaneous, and the results showed little contradicion in the results of the first and second exposure, though the interpretations were more definite when the complete picture was shown. Eighteen out of the 24 guessed *cupidity* (or its equivalent), and 18 out of 24 mentioned *interest*, as being the expression on the face of the *L'Envie* girl. Other judgments were scattered and stated fear, surprise, stealth, etc. Cupidity as meaning strong desire is akin to envy, so we should have to call this a pretty good record. Fifteen out of 16 correctly mentioned jealousy (mostly directly by that name) in the case of the second picture; six used the word envy also, four mentioned shyness, four revenge, two sorrow, ten sulkiness. So, as far as the results of this little test go, we may conclude that envy and jealousy have a characteristic, readable, emotional expression, at least in the face.

Analysis of Jealousy as a Mental State. Several lines of evidence may be adduced to show that jealousy is not a simple mental state. Spinoza spoke of it as 'a vacillation of the mind;' James Martineau as an 'ulterior compound;' Bhagavan Dás makes it a mixture of love and hate; Irons calls it a complex state; Ribot, a 'binary compound derived from the composition by mixture of heterogeneous and divergent elements.' As not infrequently happens, the poets have already furnished a better characterization than any psychologist can provide. Shakespeare sums it all up, according to Finck, in his two lines,

> 'But, O what damned minutes tells he o'er
> Who dotes, yet doubts, suspects, yet strongly loves.

W. Collins in his Ode to Passion, it seems to me, has done as well:

> 'Thy numbers, Jealousy, to nought were fixed:
> Sad proof of thy distressful state;
> Of differing themes the veering song was mixed;
> And now it courted Love, now raving called on Hate.'

Our returns abundantly bear out this conception of jealousy, and give us some idea of what are the differing themes. One hundred and twenty-two persons in their introspective accounts mentioned *anger*, as one of the elements. This heads the list. Eighty-four mention *self-pity;* 32, *grief*, sadness, sorrow, melancholy, dejection, despondency; 60, *mortification;* 39, *fear* and anxiety; 55, *hatred*, revengeful thoughts, desire to injure, rancor; 21, *sulking*, impulse to flee from the irritating situation, desire to seclude self and to cry; 21 mention other feelings not falling under the above heads. In one given individual, whatever brand of jealousy he may have, the complex

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is even for him a veering thing, with now this element now that element prominent. And between individuals the permutations are many. Anger, self-pity and grief constitute the most usual combination, and the resultant jealousy falls into the sthenic or asthenic type, according as the first or last element is predominant. The two grand divisions are 'the jealousy which suffers and the jealousy which is angry,' but either anger or grief may be lacking in any given state.

We shall not push our analysis until we have cited some concrete descriptions, by persons who themselves have undergone the experience of jealousy.

F 22. Jealousy usually arouses in me a feeling of self-pity, anxiety or fear, rarely any of the other more violent emotions. The attack may be sudden or it may be the reaction from some previous strong feeling. The sudden attack comes and goes quickly. My hands always grow cold. A sudden chilly sensation of the spinal column has once in a while accompanied the attack.

F 22. I simply felt a heavy, sinking feeling all through me; hated everybody, and was very nervous; often sulked.

M 23. I felt exceedingly pained at being surpassed in any kind of play and also in love. Toward a rival in love, I felt that he was cruel to all, unfit for his high position. I killed him often and often committed suicide.

F 20. I can scarcely describe how I feel. I get desperately 'blue,' also feel pity for my miserable self, and these are about the only times that I ever cry; I just want to go off somewhere and hide. The attack comes in a flash; merely an action or word on the part of the person may bring it on, and make me miserable for a week and often much longer. Once in its throes, self-control is of no avail; it simply has to wear off of its own accord.

F 18. At first I could n't cry. I just shook with sobs and then I cried as though my heart would break, fell on my knees and began to pray.

F 18. When I am jealous my muscles feel stiff, my heart beats fast and I feel as though I could not draw my breath. Sometimes it seems as though my heart really aches.

F 19. The attack comes on suddenly; when by some word or act I am led to think I am not first in the third party's affection, a pang, a sort of darting pain, goes through my heart, my face clouds over, my lips compress, a chill, stony feeling comes over me, and I pity myself. If I have anything in my hands I clench it tightly. The pain darts through in a second and then I try to shake off the resulting numb feeling. The spell lasts about five minutes; after the spell I am depressed.

F 22. When I am jealous there seems to be something griping my heart. That is all. I feel no anger, no desire to injure, just a feeling as if my heart would break. There is a lump in my throat. I brood, but never give signs of my jealousy outwardly, and I confess that I can't very well drive away the feeling.

F 19. I feel very angry. My face gets very red. I can almost feel my blood boil; by this I mean I have a queer sensation in my body. I was grieved and also felt fear. I felt as though I could tear my rival to pieces.

M 31. Attack is never acute or spasmodic as far as to bodily manifestations, but I have often had a sudden rush of the feeling which

caused almost a sinking at the pit of the stomach or tendency to nausea, with flushing. Though often aroused suddenly by trivial circumstances and suspicions, it is rather a prominence on a regular plateau of the chronic feeling entertained toward some rival.

F—. Three times I have suffered very acutely through jealousy toward girls or the women who were favored by the youths or man I loved. My earliest experience came at about 16 or 17, and my feelings were revealed by crying, melancholy, intense longing for dark eyes, graceful figure, and all the superior physical attractions possessed by those I was jealous of. Many physical sensations, as a feeling of a heavy hand grasping the heart and producing actual pain; depression; loss of appetite; loss of sleep; restlessness; desire to walk far away and alone; brooding over what might have been had I only possessed beauty or superior vivacity,—these all accompanied every attack of 'this green-eyed monster.'

F 28. At the first instant I feel a desire to injure, a cold stiffening of my tongue, a cold creeping at my heart. I never can say a word or I say the wrong thing. Am angry, grieved. I feel as if paralyzed. After such an attack I am quite undone, sick, tired, and dissatisfied with myself. I try to exercise self-control but it helps little.

F 31. I felt a nasty, disagreeable pang in my heart. I could cry for hours, lying in a secluded garden corner, or in my room, thinking of all sorts of things, suicide, murder, flight. This feeling vanished, but even when the man was no more loved I felt the same pang when I saw him with another.

M 24. I feel very unhappy sometimes, especially as jealousy makes me lose confidence in those nearest to me. I would be very happy if science could help, it is my great wish and therefore I will be frank. My outbreaks are uncontrollable, I make a row, a scene, and often have had duels. I know I am a brute. I never allow any one to approach the woman I love or court, even if it is a passing flame. I cannot bear to see another man near her. I would kill him. I feel hot, flush, my eyes flash, — it is a most miserable feeling.

The characterization of envy and jealousy in proverbs and poetry, give further insight into the psychology of the subject. The emaciating aspect of envy is most often seized upon in these references: 'Rust consumes iron, envy consumes itself.' 'An envious man waxes lean with the fatness of his neighbors.' 'As a moth gnaws a garment, so does envy consume a man.' 'Base envy withers at another's joy.' 'Envy is the worst disease.' 'Envy is the dyspepsia of the mind.' (Punch.) 'Nothing can allay the rage of biting envy.' 'Wrath is cruel and anger is outrageous, but who is able to stand before envy?' 'The envious man's face grows sharp and his eyes big.' 'Envy pines at good possessed.' (Cowper.) 'A sound heart is the life of the flesh; but envy, the rottenness of the bones.' (Bible.)

Shakespeare variously calls envy, black, devil, sharp, monster; and speaks of 'Lean-faced Envy in her loathsome cave,' and of 'the brinish bowels of some envious surge.' For Pope 'hateful envy' 'howls,' is 'pale' and looks 'wan,' and 'Listening Envy drops her snakes.' Perhaps the most exquisite and masterful literary study of envy is found in the dramatic mono-

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logue by Robert Browning, entitled, 'Soliloquy of the Spanish Cloister.' The first stanza may be quoted:

"Gr-r-r — there you go, my heart's abhorrence!
Water your damned flower pots, do!
If hate killed men, Brother Lawrence,
God's blood, would not mine kill you!
What, your myrtle bush needs trimming?
Oh, that rose has prior claims —
Needs its leaden vase filled brimming?
Hell dry you up with its flames!"

If Envy carries snakes, Jealousy is itself a monster with green eyes. In Japan it is proverbially associated with a horned dragon, and the literal translation of the Japanese phrase 'to be jealous' is 'to grow a horn.' An African proverb says, 'A jealous woman has no flesh upon her breast, for however much she may breed upon jealousy, she will always be hungry.' 'Jealousy is worse than witchcraft,' says a European proverb. 'Jealousy is the greatest evil.' 'The jealous man spreads his bed with stinging nettles and then sleeps on it.' Shakespeare also calls jealousy a mad devil, and thinks 'The venom clamors of a jealous woman poisons more deadly than a mad dog's tooth.' The Biblical description again, is vivid: 'Love is strong as death; jealousy as cruel as the grave; the coals thereof are coals of fire, which hath a most vehement flame.'

It is the plurality and diversity of the elements in the jealousy psychosis, combined with their hyper-personal character, that makes it so cruel, so poignant. Bhagaven Dás is of this opinion: 'In its intenser forms, connected with sex-love, where the Love . . . is the greatest, the Hate is naturally at its worst; the consequence is that Jealousy is an emotion which may be said to disturb the mind of the human being, sway it, tear it in two more powerfully than any other emotion.' (10, p. 83.) James observes that the strain on actors playing the part of the jealous Moor in Othello is exceedingly severe. 'Coleman was always physically prostrate after the play and could not get a pigment which would stay on his face.' (24, Vol. 2, p. 465.)

But through the heart
Should Jealousy its venom once diffuse
'T is then delightful misery no more,
But agony unmixed, incessant gall,
Corroding every thought and blasting all
Love's paradise.

It has been named the 'King of Torments,' and Spenser says, 'Of all the passions of the mind thou vilest art.' Finck is probably right when he calls it, 'The keenest agony known to mankind.'

Genetic development and scope of jealousy. Much of this peculiar anguish is due to the fact that jealousy, at least in its intenser forms, is the acutest hyperself feeling, the keenest self-consciousness experience, which falls to the lot of man. It is pre-eminently an anti-social, self-regarding emotion. In tracing its genesis, we should, therefore, go back to the most primitive feelings of self in the evolutional scale. "In a certain sense," according to J. W. L. Jones, "self-consciousness is coeval with consciousness itself." (25, p. 38.) The lower animals cannot, of course, be credited with a self-consciousness so highly developed as to be conscious of 'the subject whose activity is the subject's object;' but for our purposes a broader conception than this will be serviceable. We shall consider all feelings connected with the instinct of *self*-preservation and *self*-aggrandizement, as either implicitly or explicitly representing a self-feeling. The very definitions of the most primary and irreducible animal feelings like anger and fear, bring in this ascription of a self. Anger is called *self*-aggressive; fear, *self*-defensive. Thus Stanley says, "In fear there is an elimination of oneself from the injury, in anger elimination of the injury from oneself."

In the human self-feeling, according to Ribot, the primary fact is "the feeling . . of personal strength or weakness with the tendency to action or arrest of action." Now it is within the bounds of caution to attribute to all conscious animals a corresponding self-feeling, meaning thereby the halo of pleasure-pain feeling which attaches to intra-organic functioning and adjustment to environment. The base-line of the self-feeling will be physical comfort and discomfort, but its exact nature must be left to individual conjecture.

The first rudimentary emotions to heighten this self-feeling are waves of fear and anger. When these are unblended, undifferentiated, we have nothing, as yet, which may legitimately be called jealousy. But when by reason of more and more complex rivalry situations, which higher organisms have to meet, these two feelings oscillate, conflict or combine with other elements, there may result those peculiar states of antagonism and discomfiture, which, because of their peculiarity, should be called jealousy. The creature becomes jealous when the domain of self is trespassed upon by a rival, or threatens to be so trespassed. The self-sufficiency, complacency, security of some well protected, stolid beasts, suggest anything but jealousy; and their serenity is surely farther removed from such a state than the chronic watchfulness and trepidation of so many preyed-upon fauna.

Whatever may be the character of the sense of self in the higher animals, certain it is, that they act as though their

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homes, their feeding grounds, their eggs, their cubs, provender and mates were very parts and parcels of themselves. Galton's brilliant description of the sociability of the South African ox forcibly strikes us as being a parallel of what happens in the human family when a man suddenly finds the cherished domain of self sundered by the triumph of a rival lover or business competitor. "An ox when separated from his herd exhibits every sign of mental agony, his glance is restless and anxious and is turned in succession to different quarters; his movements are hurried and agitated and he becomes a prey to the extremest terror, . . . (he) cannot endure even a momentary separation from his herd. He strives with all his might and main to get back, and when he succeeds he plunges into the middle to bathe his whole body with the comfort of closest companionship." Who will deny that this bovine behavior closely resembles the frenzy of human jealousy, and indicates the capacity of even a quadruped to feel shrinkage of self and to take comfort in the restoration of self? The psychology of animal jealousy, then, reduces itself to this: a sense of self highly enough developed to feel imminent or accomplished deprivation in situations of rivalry.

Now in children, as in animals, we should expect the first forms of jealousy to be very rudimentary. If, as seems to be the case, the first manifestation of the proprietary instinct is toward the maternal breast, we may look there for our earliest human jealousy. So far as the infantile sense of self is concerned, it consists in the swaddling period, of bodily feelings of comfort or discomfort, including everything external to the body which becomes connected with its physical welfare, such as the breast, the nurse's face, the father's shining spectacles, the lullaby, etc. These alterior factors are probably earlier and more intimately parcel of the dawning feeling of self than the infant's own hands and feet. At any rate it is true, as Baldwin says, "To be separated from his mother is to lose part of himself, as much so as to be separated from a hand or foot."

It is evident that young infants have a sense of self sufficiently real, to be able to feel the pangs of deprivation, beyond mere organic hunger. At the earliest stage it is solely a sensitiveness to dispossession of things material, which minister to the instincts of food and play, and for several years lusty infantile fights are waged, on account of a jealous regard for these things. But surprisingly early we have the dawn of something which contains the promise of higher forms of jealousy. This is the social sense. The following is taken from the manuscript notes of Dr. T. L. Smith, on the Japanese baby, Kiku. "Her social sense appears to have been an early devel-

opment, for Dr. C. A. Osborne reports that she cried at being left alone and showed signs of content at having some one near while in the hospital (age three weeks). The first incident, however, which seems to show a distinct element, is recorded in the 16th week, when she was very much interested in a rattle for about ten minutes, but every few minutes turned away from it, looked up into my face with a smile, and then turned back to the rattle. This suggests a seeking for sympathy, though probably in a very rudimentary form." Since then Dr. Smith has noticed a fretting cry, not of bodily discomfort, but of emotional distress, when Kiku's mother would suddenly leave the room or would attend to the typewriter instead of to the baby. Is Kiku jealous of the typewriter? The very suggestion of the question shows that we are dealing here with something which may develop into true jealousy as soon as the sense of self becomes sufficiently ejective.

Miss Shinn noted the same fact in her niece at about the same age. "It was about ten days before the end of the month (sixth month) that she first showed a decided *emotional dependence* on her mother. She had been separated from her for some time (by a tedious dentist's engagement), had become hungry and sleepy and had been frightened by an abrupt stranger. At last she settled into a pitiful, steady crying, stopping at every angle in the corridor where I walked with her, and watching eagerly till it was turned, then breaking out anew when her mother did not prove to be around the corner. This tragic experience left a much deeper mark than the physical woes, and for some days the baby watched her mother rather anxiously as if she feared she might lose her again unless she kept her eyes constantly on her." (37, p. 180.) The baby's emotional dependence was a sign of her capacity to fear and to feel the deprivation of something that ministers to self,—a capacity which is at the bottom of all jealousy, animal or human, material or affectional.

Paola Lombroso's explanation of infantile jealousy, it seems to me, is in harmony with the general interpretation of jealousy here offered. 'The fundamental law of child psychology which co-ordinates and explains the facts of child life is the strong sense of *self*-conservation and *self*-protection, the jealous care with which the child seeks to preserve himself from everything which can hinder or impede even in the slightest degree his development.' 'The child loves merely because of immediate benefit and pleasure conferred upon him.' Lombroso cites as an example a very good, intelligent child who all at once became fiercely jealous, when having broken his leg he had to stay in bed more than a month, and could no longer endure that his little sister should come into the room, to take his mother's

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attention in the slightest degree. Later this child in giving an account of this jealousy which was short lived, said, "I love Lia now, but when I was ill I did not love her."—'In this case is seen in schematic form, what jealousy really is,' thinks Lombroso; 'a child becomes jealous, when he is weaker, when there is awakened in him a more imperative need of being supreme in affection and gathering to himself all the benefit.' (30, ch. 1.)

Without attempting to trace in detail the dialectic of the developing personal self from infancy on, it may be said that by impingement upon a social environment, the sense of self deepens and expands, becomes more of a socius; and the nature of the jealousy experience grows *pari passu* complex. Jealousy, as one correspondent stated the case, is 'an important phase of the divine spirit of selfishness, which is identical with the instinct of self-preservation.' It may also be subsumed under the protean conceptions of property and of pride. It is the instinct of appropriation embarrassed by a rival, the impulse of domination obstructed, the pleasure of triumph denied (or threatened): it is thwarted pride. It constitutes the substratum of a multitude of childhood foibles, adult littlenesses and exactions, and is a motive in many situations, where we do not ordinarily consider that it exists at all. Many children's lies, I should say, spring from a tendency to level down inequalities, to dominate in spite of everything, and are crude expedients whereby the child saves himself from the pangs of inferiority or self-insufficiency. Dr. Steinmetz's theory of revenge makes it a desire to enhance self-feeeling, and many of the uncanny, malicious acts of children are prompted by such a revengeful jealousy. Thus we have the getting-even, the paying-back psychoses, the calling names, making faces, the don't-speak snubbing, so plainly prevalent among children,—and grown ups. Calling a fortunate rival a scamp, or making some false accusations concerning his victory, repaying slight by another slight, establishes something of an equalization, and wheedles self-pride. A nice white apron is a glaring sign of superiority of Mary over Jane; but a daub of mud soon sets matters right for Jane. If we cannot exalt ourselves we humiliate others, and make ourselves worthy by making them feel cheap; the net result is the same: a more non-irritating level. Similarly, adolescents are prone to resort to extreme ruses all for the sake of forestalling the bitter sense of being outdone.

Revenge is exercised for the same general reason that we desire restitution, when we crave forgiveness on the one hand or exact apology on the other. The administration of justice even is, or historically was, motivated in part by jealousy. Tattling is akin to revenge. Tattling, especially on rivals and

teacher's 'pets,' is an inveterate tendency among children. It is the counterpart to the gossip phychosis of their elders. Both are colored by feelings of elation, superiority, smugness; the self is flattered and dark hues are painted upon other selves to heighten the contrast. Rumor is a pipe, and one of the winds which blows it is jealousy. Some one has said rather cynically, 'Envy will be a science when it learns the use of the microscope.' Nothing so sharpens eyes and tongues as envy and jealousy. 'Bad eyes see no good;' sharp tongues derrogate and are sarcastic.

Why are gossipers, and many other people, so inordinately stingy with praise? Why do compliments and congratulations so often give a tug at our heartstrings when they are reluctantly released? Because there is a jealous, ever comparing sense of self-conservation, so sensitive that it suffers from the mere comparisons it makes in favor of another self. Why do we take slights so to heart? Why do children take hazardous dares so readily? Why do we resent taunts, and indeed charges of jealousy? Why cannot some natures brook the slightest criticism or disobedience or accept the kindest advice? And what is the psychological reason for our strong aversion to presumptiveness? There is nothing so intrinsically or ethically despicable in mere conceit, to warrant our tingling contempt for it, and our discomfort. Rather, our irritation is unreasoned, absurdly out of proportion to the cause; the reaction is one of instinctive jealousy.

Normally the intensity of all our jealousy should be inversely proportional to the degree of security we feel. But this instinct has such a momentum behind it, that often its intensity proves ridiculously great when measured by the triviality of the exciting event. This is because in the state of nature jealousy was frequently associated with life and death situations, arousing the creatures to their cruelest ferocity; the most ferocious were victorious and left offspring; they were our ancestors. As Othello most significantly said, "Nature would not invest herself in such shadowing passion, without some instruction." Almost every mother is extremely sensitive about any judgment passed upon or treatment shown her children, who are so much parcel of herself. Here the jealousy probably gets an impetus from the many ages of discipline in the prehuman epoch, when every breeding season called out in the female an impulse to watch and to protect. The most pitiful discrepancies between stimulus and reaction, however, come out in the pathological sexual cases, where the victim is 'as jealous as Ford that searched a hollow walnut for his wife's leman.' (Shakespeare.)

As one self contracts, the other self, which is the cause of the

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shrinkage, enjoys a corresponding expansion and tends to display and show off its power, and our correspondents often confess, that they feel elated, exultant, proud, patronizing, delighted, self-satisfied, domineering, and triumphant, when they realize that another is jealous of them. One calls it 'a wicked feeling of triumph and elation.' Another says, 'I feel a certain glory in the fact. I desire to exercise what power this jealousy may give me to increase the feeling.' Still another writes, 'When I know a person to be jealous of me, I am triumphant and happy. I feel cruel and try to make her more jealous. It makes me feel wicked but it is a delightful sensation.' In pathological cases, such egotism at another's expense is greatly exaggerated, and the paranoiac finds pleasure and fear in the delusion that the whole world is envious or jealous of him.

Instinct and human social organization have conspired to make the self sensitive. That this self, to which we are so often referring, is no metaphysical abstraction, but a psychological reality, most intimately concerned in the jealousy complex, is shown by the fact that *self*-pity is so frequently part of the psychosis. The presence of this self-pity reveals the peculiar subjectivity, which differentiates jealousy from the simpler, more objective emotions. For jealousy in its higher forms is not like anger, a whole-souled *outward* reaction, but is full of schism, conflict, and introspection. The soul, as it were, splits, and by a miracle both cruel and comforting, subjects itself to its own examination, puts itself upon a rack, gloats over its own sufferings, partakes in them, and pities them. If there is any glint of luxury in jealousy it is by virtue of the self-pity.

"A man's Self," says James, "is the sum total of all that he can call *his*, not only his body and his psychic powers, but his clothes, his home, his friends, etc." (24, Vol. 1, p. 291.) The more highly organized and extensive this self is, the more scope and depth it gives to jealousy. When a self expands wide enough to include not only family, but race and nation, a man may come to be hateful or jealous toward rival races and nations. "The most peculiar self which one is apt to have," however, says James, "is in the mind of the person one is in love with. The good or bad fortune of this self cause the most intense elation and dejection." Although a miser may feel 'personally annihilated' at the loss of his beloved gold pieces, and though the news of a wrecked fortune may bring a cataclysm to the personality of a business man, the most dramatic and instinctive exhibitions of the 'property psychosis,' of jealousy are in regard to the peculiar kind of self, mentioned by James. Every lover will freely declare that the better and

greater half of his self, is that immeasurably precious portion of personal property, the object of his love. On the principle of *no love, no jealousy* (which is a proverb in Italy, France and Germany), the greater the love, the greater will be the jealousy. Let any rival break in upon the harmony of love, and the perturbation will correspond to the power and complexity of the original feeling.

Finck makes jealousy one of the 14 indispensable overtones or ingredients that go to make up modern romantic love. For him, jealousy is a savage Cerebus, the watch dog of Monopolism, which latter is the proprietary ingredient. "A genuine Romeo wants Juliet and nothing but Juliet." "I had rather be a toad, and live upon the vapor of a dungeon," said the jealous Moor, "than to keep a corner in the thing I love, for other's uses." Why this terrific monopoly? Psychologically, because the Loved One is in very truth the Self, and jealous monopoly is but self-conservation. The straits to which intrusion into this most sacred shrine of self will drive the outraged man, literature and life abundantly illustrate. He may kill one, or two, or three persons: his rival, his idol, himself. To kill the first is simple, instinctive, defensive, man-slaughter; to kill his beloved is really dire suicide, but seems to him warranted, and to next wipe out the miserable remnant of self that is then left in him, only completes the suicide. He may kill in mere reflex, brutal rage, or in cold-blooded bitterness; but he may also kill in love, as surely did Porphyria's lover in that beautiful, or at least æsthetic murder, described by Browning.—Her yellow, golden hair "I wound, three times her little throat around, and strangled her. No pains felt she; I am quite sure she felt no pain. As a shut bud that holds a bee, I warily opened her lids: again laughed the blue eyes without a stain. And I untightened next the tress about her neck; her cheek once more blushed beneath my burning kiss."—Well may the poet ask,

> How comes this gentle concord in the world,
> That hatred is so far from jealousy?

At the lowest end of the genetic scale is the animal rage of sexual rivalry, at the highest end, an angerless jealousy, all motivated and swallowed up in love,—"a kind of godly jealousy, which I beseech you, call a virtuous sin."

III. The Special Aspects of Jealousy.

Pathology of jealousy. This is a painfully interesting chapter and has received the lion's share of scientific treatment. Some may be disposed to argue that *all* jealousy is pathological, like the Frenchman who said, "*La jalousie est la soeur de l'amour, comme le diable, est le frère des anges.*" Indeed, Ribot

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quotes a contemporary writer who defines jealousy as "a *morbid* fear passing from inert stupidity to active or passive rage." Mantegazza called it "a constitutional psychological malady." Burton styled it "a bastard branch of love melancholy." (7, p. 626.) But granting that there is a normal jealousy, it will still be difficult to determine where the same ends and where the abnormal begins. Moreau makes five gradations of intensity from the feeble jealousy to exaggerated. (31) Imbert distinguishes three degrees: *l'obsession*, *l'idée fixe* and *le delire de la jalousie*; but he admits there are so many intermediate degrees that the distinctions are hard to maintain. Imbert also differentiates between idiopathic and symptomatic forms (22). Nosologically, Fere and Dorez suggest that morbid jealousy be classed among the phobias (13). Villers, however, thinks it should be ranged in the great group of delusions of persecution (43). He would, accordingly, make all cases of the disease varieties either of *paranoia alcholia* or *paranoia sexualis*.

Villers, who has made one of the most comprehensive studies of the subject, lists the causes for the affection in the following order: psychic degeneration, alcoholism, hysteria, neurasthenia, troubles with the female genital functions (especially at the climacteric), cerebral traumatisms, senility and cocainism. Almost all cases are engendered by alcoholism. Krafft-Ebing observed morbid jealousy in 80 per cent. of alcoholics still capable of sexual life (28); but the examination of many hundreds of paranoid patients without alcoholic history, revealed not a single case with delusions of jealousy. Excessive inebriety, though at first producing hyperæsthesia, finally results in atony of the genital organs and this diminished sexual ardor seems to form the foundation for the conception of jealousy and its characteristic obscene and erotic accompaniments (6).

Dorez distinguishes between the active and passive cases. The former are represented by the excited, maniacal *persécutes-persécuteurs*, and tend to murder. The latter, which are much rarer, are marked by reserve, melancholia, hallucinations, and tend to suicide. (13) Stefanowski makes two grand divisions: (a) hyperæsthesia of jealousy, and (b) anæsthesia of jealousy. The first class is the more numerous. Everything that "the insane person sees, hears, feels, the perfume of a handkerchief, a look, inspection of undergarments—all furnish traces of an odious infidelity." The unfortunate victim goes to the most pitiable and unwarranted extremes, bathes letters in chemical solutions to discover lines written in sympathetic ink, makes microscopic investigations, "ceaselessly plagues his family with his complaints, reproaches, his despair," and often in a delirium of drink, suspicion and rage, he kills. Sometimes the jealousy is retrospective and is based on circumstances which happened

and were forgiven years before. Stefanowski reports such a case in a young Russian, naturally genial and generous, who goaded his wife to confess and reconfess a former faithlessness, and finally beat her to death with a cowhide. (39, p. 387.)

In the anæsthesic class fall the cases no less sad, though more despicable, of the blackmailer who profits by the prostitution of his wife, of the man with such excessive coldness that he divides amours with a rival. Though fierce jealousy is found even among prostitutes and *souteneurs*, society with them tends to extinguish jealousy. Here we have the other side of the picture, which is instinctively repellant, and leads one to recognize that there is a normal jealousy which lies somewhere between the anæsthesic and hyperæsthesic forms.

CRIMINOLOGY OF JEALOUSY. Should the murders prompted by jealousy be called criminal, pathological, or neither? Alienists appreciate both the difficulty and great forensic importance of this question. The public pardons no other kind of manslaughter more readily, and in France, at least, the tendency has been to let such murderers go free. Thus, in one case, a married woman killed her rival six months after the discovery of her husband's adultery, but the court refused to punish. In another case a man who suffered horribly from the tortures of jealousy rose one morning covered with cold sweat, and shot his unfaithful wife. "The medico-legal report declared him irresponsible on the ground that he had obeyed an irresistible impulse which had annihilated his will." (39.) Marc makes the general statement that "Jealousy nearly always decreases the criminality of the deeds which it prompts."

Dr. Hans Gross in his *Kriminal-Psychologie* says that envy is more irreconcilable and by far more universal than other forms of hate, and that it is impossible to overestimate its danger. "Through no other passion, perhaps, are so many lives endangered and destroyed, so many undertakings thwarted, so much that is worthy made impossible, so countless many persons misjudged." (17, p. 555.)

Important as envy and jealousy are as causes of crime, I am informed through a letter from expert special agent, John Koren, of the bureau of census, division of Vital Statistics, that "The criminal statistics published by the goverment yield absolutely no information of value on this subject, nor can anything be found in institutional reports." One fugitive reference states that in the year 1874 jealousy caused the suicide of twenty men and six women in France. (13, p. 50.) Morselli says that for a period of ten years in Italy, comprising 10,347 suicides, jealousy caused nine out of every one thousand with women, and six out of every thousand with men. (43, p. 150.) The present writer secured from a clipping-bureau, newspaper

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accounts of 'criminal jealousy,' covering all the United-States for 24 days, from May 10, to June 4, 1906. Although these data are undoubtedly incomplete, they are suggestive. Eleven cases of assault not issuing in immediate death were reported, including six cases of shooting, one of stabbing, two razor attacks, and two cases of acid throwing. In addition, there were for this period, seven cases of murder, and seven of suicide.

Envy and jealousy also constitute a prominent factor in juvenile crime. Dorez and Moreau cite several cases in young children. One boy of 10, jealous of the caresses which his mother seemed to lavish on his little brother, 6 years old, cut his throat with a razor. Another boy of 12 in a violent attack of jealousy strangled his little sister, still in the cradle, by forcing a candle into her throat and then filling her mouth and nostrils with hot cinders. In our study of the actions of normal children prompted by jealousy, we often came across deeds verging on criminality. It would seem that this passion merits more attention than it has received, from students of crime.

The question of *sex differences* in criminal and normal jealousy is very complex and delicate. The weight of quotable (male) authority is to the effect that women are more susceptible to jealousy. Confucius said, "The five worst maladies that afflict the female mind are indocility, discontent, slander, jealousy and silliness. Without doubt, these five maladies infest seven or eight out of every ten women, and it is from these that arises the inferiority of women to men." Confucius also made jealousy one of the seven just grounds on which a woman may be divorced. (18, p. 127.) Among the Japanese, it is considered to be an effeminate and feminine trait, and it is one of the first precepts to girls not to yield to it. Weininger says, "Apparently all women are jealous." Heinrich Schurtz finds that woman has less capacity and inclination for social organization than man, and attributes it to the mistrust and ill will which they have for their own sex, and their propensity to gossip. (36, p. 17.) One interesting sex difference has been noted in marital jealousy: a man does not abhor his rival as much as a woman does hers. Marro found the instincts of envy and jealousy were more frequent in young women than in young men, in the ratio of 17 to 1½. But, as Dr. Hall observes, "If it be true, that, as in matters of the heart in general, women are more susceptible to this passion than men, it may well be doubted whether, if it be broadly interpreted, man in his own sphere is not as liable to it." (19, Vol. 1, p. 357.)

PEDAGOGY OF JEALOUSY. The question of sexual jealousy will not be taken up in this connection, for it has been sufficiently alluded to elsewhere. Granted a certain ideal of the

family, a proper amount of this passion is most desirable in both romantic and conjugal love. But, happily, it may in most cases be left to take care of itself, nature having furnished the necessary instruction. Its instinctive character should always be recognized, and the danger is that it may often be too easily called out by too slight occasions.

To make a sweeping statement, however, and to say, as Thorndike does, that, "jealousy and rage, for instance, could be omitted from human life with little loss," is rather unwarranted. Oppenheim makes a similar statement and thinks 'every one will unhesitatingly agree that such an emotion as jealousy, however instinctive, is both useless and vicious, that it cannot possibly cause any good result.' These views cannot be left to stand without qualification.

Abbe de Fénelon in his book on The Education of Girls, says, "Jealousy is more violent in children than one would think. They are sometimes seen to languish and waste away with a secret grief, because others are more beloved or caressed than they. Making them suffer this torment is a cruelty too frequent among mothers, but you should know how to use it in a pressing necessity as a remedy for indolence." Rabelais, Bossuet, Locke, Rollin and the Jesuits, likewise, recommended rivalry as a stimulus in instruction; but the classic protest against this doctrine, the effects of which protest are seen to-day in the auto-emulative system of notebooks used in the French schools, was framed by Rousseau, who said, "I prefer a hundred fold that Emile not learn at all, what he learns through jealousy or vanity. I would stimlate . . . without rendering him jealous of any one. He would desire to surpass himself."

Those who, contrary to Rosseau, believe in the spirit of rivalry, are inclined (travelling the easier road) to say, Abolish jealousy by substituting for it noble emulation. But the matter is not so simple. Psychologically, the latter is very much like the former. A correspondent writes, "when the perceptive organs apprise the brain centres of a series of facts that the brain centres interpret as evidence of a condition of rivalry, that acts as a stimulus to excite the impulses of antagonism. The finished product is jealousy. In its mild form, we call it emulation and try hard to define it as something different from jealousy. So far as my experience goes, I am convinced that emulation is only a lesser degree of the same feeling that prompts one to murder his rival. They are both aroused by the same set of mental operations, and the mild form often becomes more intense, revealing its true nature." As Beattie says in his Moral Science, "Let the man who thinks he is actuated by generous emulation only, and wishes to know whether there be anything of envy in the case, examine his own heart."

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G. E. Dawson thinks that the "sinister passions of anger, jealousy, envy, and oppression indicate the inertia of the human soul, and its resistance to radical processes of change." To him envy and jealousy are psychic rudiments, dating originally to a feral utility; and now their complete elimination should be affected by the processes of atrophy and transformation. "The exercise of continual caution in not tempting children to envy and jealousy sums up the pedagogics not only of common sense, but also of evolutionary law. Where function of the immoral diathesis does not occur, reduction must inevitably follow." (11, p. 221.)

The trouble is, we have as yet no system of ethics by which to measure the immorality of this diathesis, and thoughtful teachers and parents are often at a loss how to regard this passion, when manifested in the young. It certainly awakens a great variety of often contradictory 'moral' responses in those who see this trait in others. Two hundred and four persons frankly told how they felt toward a person whom they knew to be jealous of them. Twenty of them admitted indifference; 37 shunned the person because of fear, awe, coldness, or suspicion; 47 expressed contempt, dislike, anger, disrespect; 37 felt exuberant, proud, triumphant; 32 were led to aggravate and torment; 79 felt kindness, pity, or sorrow, and of these only 23 distinctly say that they try to remove the cause. One tried to be friendly, for she considered jealousy the height of misery, another would humble herself, another would put herself in a ludicrous light, and one even confessed to lying in order to allay the pangs of jealousy.

The whole problem is complicated by so many factors, such as age, sex, temperament, frequency, circumstances, etc., that one hesitates to make generalizations. Attacks of jealousy affect one individual in one way, another in a different way. A few say, that by the force of rebuff generous impulses follow experiences of jealousy. Thus one man says, "Many of the most magnanimous things I have ever done have been done to abase or mortify this instinct." Others feel morose, fretful, cross, mean; some mention physical fatigue, exhaustion, nervousness, loss of appetite; while a few feel relieved. The majority (76 out of 120) say they feel ashamed, dispirited, blue, mortified, penitent, discouraged, humiliated. There are few things which incense a person so promptly as imputations of jealousy; it is so distinctly a matter of self-hood, that even in children it should be treated with utmost delicacy, and care should be taken not to add gall to bitterness by formal precepts about jealousy at the unpsychological moment when the soul has already decided of its own accord, on the unloveliness of the experience. Similarly, it does not add to the sweetness of

disposition to play on the jealousy of little children; for this is likely to result in hatred toward parent or teacher, and rival. One kind of jealousy (and there are many kinds) should not be irritated, and should be dreaded as much as a most insidious disease. This is the chronic jealousy between sisters and brothers. The infantile variety which is transitory and explosive leaves no marks; but there is a more sinister variety developed in later childhood and adolescence, which may leave ineffaceable scars. Judges of probate courts can testify that if once the spirit of jealousy is allowed to oppose the peaceful settlement of a testament, a canker has been planted which it is almost impossible to kill, and the family ties are sure to be permanently demoralized. Felix-Thomas rightly deplores that we do not have more and truer *Geschwisterliebe* in our homes, and finds the most redoubtable enemy thereof to be juvenile jealousy, which changes confidence to suspicion and sympathy to aversion. (41, p. 158.) Good honest fights between brothers and sisters are not so deleterious; but the vexation of spirit, and sour quarrelsomeness, and querulousness that accompany jealousy are matted weeds which stifle the flower of *Geschwisterliebe*, and often, too, of filial love. The best horticulture or pedagogy in this case is tactful, and preventive. Courtesy and generosity are best inculcated for their own sake, and not in contrast to jealousy. The child is likely to resent direct precept by reason of the very sensitiveness which makes him jealous, and the effective methods are indirect. It should be remembered that children crave attention in a manner and intensity different from adults. Even an infant will hold out a hurt finger to be kissed, and parents ought to be cheerfully willing to assure and reassure and reassure by formal word of mouth, that they love all their children equally well. This practice, as our returns show, is effective, and supplemented by substantial impartiality would save many pangs and produce good results on the family life.

The child and the sensitive adolescent temperament always need the assistance of sympathy and justice from their social environment; but whenever the self is vigorous, and developed enough it tries to take matters into its own hands. For most of those answering the questionnaire, the attacks came on suddenly, and although some confess entire inability to regulate them, many resort to more or less successful devices of control which are pedagogically suggestive. The following may be mentioned (condensed from the original statements): thinking of good qualities of the rival; turning the attention to other things, as reading, playing the piano, singing, joking, having a good cry, putting self in place of the person of whom jealous; saying something nice about or to the person; prayer,

saying, 'What's the use?' and dwelling on the ugly side of the passion. There is an element of control and assuagement in the very self-pity which is so often part of the jealousy complex. Sometimes the injured self finds refuge in imagination, by picturing fanciful situations where it is the centre of attraction and applause; or recalling the one or two cases in which it stands first in the affection of another, or in accomplishments. As one college girl puts it, "I use a little common sense, enumerate the good things I have, and as Mrs. Wiggs says, 'I am thankful I have n't got a hair lip.' "

The whole pedagogy of control in cases of undesirable jealousy then, both from the subjective and objective side, is to say, to do, and to call up those things that restore, conserve or comfort the self which is wounded. There is a transitory, lusty kind of jealousy, which is, if anything, a good sign, for it indicates a vigorous sense of self, and the possibility of noble emulative spirit; but there is also a chronic, gnawing, envious kind, which is both physically and mentally unhealthy, which denotes rather a morbid sense of self and develops the opposite of emulation. If in this delicate and complex field, a practical suggestion may be hazarded, it would be this: Develop in your children a robust spirit of self worth; if possible let them have a hobby, a specialty, a pre-eminence in one particular,—not to foster conceit, but to promote a legitimate personality sense. This particular pre-eminence may be a haven of consolation, when buffeted by rivalry one is overcome with the sense of inferiority, and may make it possible for one to say after reflection, 'I am glad to be myself.' When the soul can say this heartily it is free from the corrosion and demoralization of intermittent, chronic envy and jealousy. Such a self need not be non-jealous, but it will be healthily jealous.

ANTHROPOLOGY OF JEALOUSY. From what we have seen of jealousy in animals and young children, we should hardly expect the passion to be absent among primitive peoples. Darwin considers "that almost promiscuous or very loose intercourse was once extremely common throughout the world;" "nevertheless," he adds, "from the strength of the feeling of jealousy all through the animal kingdoms, as well as from the analogy of the lower animals, more particularly those which come nearest to man, I cannot believe that absolutely promiscuous intercourse prevailed in times past, shortly before man attained to his present rank in the zoölogical scale." (8, ch. 18). Maine agrees with Darwin that jealousy could hardly have been dormant in primitive man, and Starcke in his theory of the primitive family combats the idea that marriage ever passed through a general polygamous stage, citing mutual jealousy as an obstacle thereto. After producing numerous instances in which

primitive man willingly surrenders his wife to others, Starcke submits that "the rule may be laid down that jealousy was only excited when the man was afraid that he should lose his wife." "There is no race," Sutherland believes, "entirely without sexual jealousy, but in some it is only slightly developed." But he mentions 17 races among whom wives are easily leant or bartered. He also found 50 or 60 races among whom the bridegroom actually prefers that his bride should already have borne a child." (40, p. 131.)

Finck goes farther than any other writer in making primitive peoples strangers to jealousy. "Among some species of birds," he says, "courtship and marriage are infinitely more refined and noble than among the lowest savages." "I assert without fear of contradiction from any one familiar with anthropological literature, that a savage or barbarian, be he Australian, African, American or Asiatic, would laugh at the idea of refusing to exchange one woman for a dozen others equally young and attractive." (15, p. 54.) "The most painstaking research has failed to reveal to me a single Indian tribe in North or South America that showed a capacity for real jealousy; *i. e.*, anguish based on a sense of violated wifely chastity and alienated affection." (15, p. 89.) Feminine jealousy is said to be lacking even in polygamous households like those of the Zulus, the Fulahs, and according to H. Ellis, of the Koreans. Finck, however, mentions that the Patagonian women fight like tigers from jealousy, and that with the Fijis plurality of wives often causes the stronger women to bite off the noses of the weaker. In spite of these fierce manifestations, he thinks primitive female jealousy only skin deep, easily placable, and concludes that "real jealousy, as a matter of fact, is unknown to the lower races, and even the feeling of revenge that passes by that name is commonly so feeble as to be obliterated by compensations of a more or less trifling kind."

Westermarck is probably a safer guide in this question, because he presents his evidence with greater care. He enumerates some eight peoples among whom there appears to be no jealousy among the women, and where in a few cases, like the Equatorial Africans, the women actually support and favor polygamy. (44, p. 495.) But against these instances, he presents an imposing list of over 20 peoples of whom the opposite is true, where the women not only fight, but commit suicide from jealousy (as seen in some American Indians). A foot-note to this list gives 17 additional references to cases of female jealousy, representing a large diversity of primitive peoples. Westermarck derives the strongest argument against the hypothesis of promiscuity "from the psychical nature of man and other mammals." He arrays evidence in regard to

some 30 uncivilized peoples, some of a very low grade of culture, who by their laws, customs, and often terrible punishments, show a capacity for jealousy. (44, pp. 117-133.) The males among some Indian tribes resort to the law of battle, and fight for the possession of their women. Surely we cannot deny them, at least, the jealousy of the stag. And as Westermarck observes, "If the hypothesis of an annual pairing time in the infancy of mankind holds good, jealousy must, at that stage, have been a passion of very great intensity."

Wm. Jones, of the American Museum of Natural History, New York, in response to my letter of inquiry writes in regard to the widely distributed Central Algonkin Indians, that (a) the dialects of their language are rich in the expression of envy and jealousy; (b) the children manifest envy and jealousy at an early period and betray it in much the same way as so-called 'civilized children;' (c) men and women quarrel among each other over property in much the same manner as 'civilized people;' there is a great deal of envious gossip; (d) envy and jealousy are reflected in proverbs, folklore and in the body of unrecorded literature of the people and are usually regarded unpleasantly; (e) the nature and extent of jealousy for wife and jealousy for husband are much the same as among 'civilized people.'

Geo. A. Dorsey, of the Field Museum of Natural History, Chicago, writes substantially the same on all these points in respect to the Pawnee Indians: (a) the Pawnee word for jealousy is *kawirao*, meaning 'hurt inside;' (b) often poor Pawnee boys in their jealousy or envy steal the clothes or other objects of boys better to do and throw them away or destroy them; (c) the Indians are notorious gossips, and formerly, the old people claim, quarreled almost constantly regarding property, especially concerning ponies, products of the chase, etc.; (d) the men among the Pawnee are exceedingly jealous of their wives, and quickly resent any attention they might bestow upon other men; the women are also jealous, but less so.

Jas. Mooney, of the Bureau of American Ethnology, writes from an acquaintance with the Cherokee, Kiowa, Comanche, Cheyenne, Arapaho, that they are all "extremely jealous of reputation, position, and ability, and in their marital relations, both men and women. They are not, as a rule, jealous or envious of property possession. The children are equally jealous of attentions, but seldom quarrel about possessions. As compared with us, jealousy is strong, envy or covetousness weak."

Geo. B. Grinnell, editor of Forest and Stream, finds very wide difference in regard to the nature and extent of wife jealousy, and credits the Crows and Arapahoes with but little jealousy, and the Cheyennes with much.

Boaz believes there is no great gulf separating the primitive and the civilized mind, and all the specific evidence just presented favors the view of Darwin and Westermarck, that there was never a time when man was devoid of the powerful feeling of jealousy.

Abundant material might be collected illustrating the rôle of marital jealousy among non-primitive peoples. It "prompted Greek and Oriental to put wife under lock and key, and Chinese to mutilate their wives' feet, and the Japanese to have their wives shave eyebrows and blacken their teeth after marriage." (16, p. 129.) Jealousy also was responsible, according to Westermarck, for the only recently abolished custom in India which demanded that the widow should be burned on the funeral pyre of her husband.

Further light on the prevalence and degree of jealousy among primitive races, must be sought in connection with their conceptions and institutions of property. Here, again, according to Kline and France, "some savage peoples are inferior to animals in that they possess almost nothing, *e. g.*, peoples in the woods of Borneo and the Forest Weddahs of Ceylon, . . . and when primitive man does hold property it is to a large extent in common." The chief form of property for the primitive horde was the hunting-ground, and this had to be jealously defended against competitors, and we may well imagine that roving bands of troglodytes often had to join in death grapple in their rivalry for the same coveted cave. But within the tribe the communistic system of ownership would tend to put a damper on jealousy, which only became strong as the conception of private property developed. "Communism," think Kline and France, "is the best evidence of mental dullness, physical laziness and primitive lethargy;" and imply that progress does not begin till jealous self-assertiveness is wakened (27, p. 440). Rousseau has painted in classic colors, the idyllic, non-rivalrous primitive state, where sinister jealousy never disturbs the calm.

All customs, laws and institutions, primitive or civilized, ancient or modern, if properly ransacked, would beyond doubt furnish material to illustrate the power of the jealousy psychosis, not only in personal, but in social matters. Such an undertaking, of course, is not within the limits of this study, but a few brief examples taken from the field of religion may be offered in passing. "Have the gods envy?" asks one of Shakespeare's characters, and answers, "Ay, ay, ay, ay, 'T is too plain a case." Jealousy was a veritable psychosis coloring all Greek mythology and literature. They and the Romans even had gods or goddesses of envy, rivalry, and jealousy, and for that matter the whole Olympian galaxy who did

not bear these names were an envious pack. Zephyrus was jealous of Apollo, Juno of Io, and Jupiter of the whole human race, especially of Prometheus. Jealousy prompted him to one of his most disreputable deeds,—the malicious Pandora box.

Among the Hebrews likewise, in bold and picturesque figure, jealousy is repeatedly ascribed to the great Jehovah. 'He is the husband, Israel, the wife; idolatry and wickedness of every kind are spiritual adultery' (2, p. 553), and often with abominations was He provoked 'whose name is Jealous' (Ex. 34:14). Jehovah is Himself made to say, 'For I, the Lord, thy God, am a jealous God' (Ex. 20:5); 'jealous with great fury' (Zech. 8:2); 'Surely in the fire of my jealousy have I spoken against the residue of the heathen.' In Mediæval Christianity we have one of the strangest outcrops of jealousy in the female mystics. With them the tables were turned: Jehovah is not jealous; but they themselves are jealous of their divine lovers, God and Jesus.

Sociology of Jealousy. To what extent has jealousy been a factor, beneficial or otherwise, in shaping social progress? The chief and fundamental unit of society is the family, and no complete consideration of the family can exclude the principle of sexual jealousy. In Sutherland's opinion, "the family is strong in its cohesiveness and distinct in its form only when there is a very decided infusion of sexual jealousy in the national character." (40, p. 130.) Imperfect jealousy among uncivilized communities tends to blur the family lines. 'Its moral mission among highly civilized persons, is to aid in developing the romantic features of love.' Even if the rude savage regards his wife as a piece of property, and even if the origin of the family is to be traced to the proprietary instinct, sexual jealousy at its best is a 'property psychosis,' whose chief function is to resent intrusion, and as such it has been the potent influence in developing chastity, conjugal fidelity, and monogamy. So long as society desires this trinity of virtues to be embodied in the family institution, it is to be hoped that sexual jealousy, at least, will not dwindle.

Jealousy as a sociological factor also raises the whole philosophy of Socialism with its theories of the present and a desirable future society. This philosophy holds that the existing industrial organization rests on the principle of competition between individuals, corporations, and nations; that this principle is an inferior one, and both should and will be displaced by the higher principle of co-operation. John Stuart Mill, writing on The Stationary State, says, "While minds are coarse they require coarse stimuli, and let them have them. I confess I am not charmed with the ideal of life held out by

those who think that the normal state of human beings is that of struggling to get on; that the tramping, crushing, elbowing, and treading on each other's heels, which form the existing type of social life, are the most desirable lot of human kind." Whether or not we agree with Mill's view that this competition is only a transitory phase of industrial progress, it is often true, as Le Bon says in his Psychology of Socialism, that present day business "competitors put up with one another because they cannot do otherwise, but the tenderest sentiment they entertain for one another is ferocious jealousy." If the co-operative commonwealth, which Socialism desires, is ever established, it must be by the blending of interests, the encouragement of Kropotkin's instinct of mutual aid, thereby reducing rivalry and lessening the occasion for jealousy. (It is interesting to notice that philosophers with socialistic tendencies, by very temperament, it seems, sometimes favor also the elimination of sexual jealousy, as indicated in the doctrine of free love, which doctrine, however, is by no means an essential tenet or corrolary of modern socialism.)

In a competitive society where jealousy is given free play, its influence is paradoxical, being in two opposite directions, one toward democracy and equality, the other toward exclusiveness and variation. This seems to be an expression of Tarde's two laws of imitation and of opposition. The first tendency is a levelling one; every man considers himself at least as good as the next and wants the same privileges, etc., is jealous if there is inequality. But by his nature he is jealous of equality as well, and wants to be different from the next man. When A buys a piano it must be, if only a little, more stylish than neighbor B's. Fancy dressmakers are said never to make two dresses just alike; their customers will not allow it. Many examples might be cited to show that in social matters, where imitation and rivalry are at work, the tendency of jealousy is both to maintain and to break a level.

This comes out clearly in the operation of *group jealousy*. Our questionnaire returns report some 170 cases of such jealousy, and many of the descriptions instructively show its great social significance. Churches might be expected to be free from this motive, but they are the most frequently mentioned in the returns. The causes given include many thing, from chimes and steeples to the size of congregations. Fault-finding gossip, 'cutting dead,' splitting into factions, and spiteful absence from union services are common manifestations.

Commercial jealousy is a species by itself, which, owing to the complexity and militancy of our industrial life, has developed many virulent and peculiar forms, from the backbiting of corner grocers, to the drastic Machiavellianism of the great

syndicates. Towns, juvenile societies, men's and ladies' clubs, girls' cliques, boys' gangs, all may develop, when the rivalry is sufficiently keen, a spirit of jealousy expressing itself in taunts, gossip, libel, secessions, exclusiveness, imitativeness. Jealousy between families expresses itself in the same general ways. Tacitus in describing the ferocity between two hostile German tribes makes a rich remark that "they hated each other like neighbors!" The 'neighborliness' of civilized families is tinctured with enough jealousy to make the simile ring true. Illustrations are hardly necessary.

Group jealousy is explainable in terms of the Self, just as is individualistic jealousy. The personal self has simply widened: "the socius, the common self of the group, comes in to drive out the narrower ego of his relatively private life within the group." By the force of imitation and tradition this peculiar social self becomes as sensitive as the private ego; sometimes it seems to be more sensitive, and a man comparatively dull or neutral in private life may exhibit intense spirit, often of a jealous kind, when his group self is irritated.

Now if churches, clubs, towns and families, are not too unwieldy to be moved by jealousy, it is probable that the larger organizations, clans, counties, nations, races, may be so moved, and we are reminded of "France and England whose very shores look pale with envy of each other's happiness." In the personal memoirs, which are the best documents for depicting the inner psychological forces which shape historical destinies, we are favored with many glimpses of our friend Jealousy, who in parliaments, diplomatic circles, congresses, official balls, in places public and private, is motivating the actions which contribute to the current of history. Balance of power, spheres of influence, partitioned protectorates, retaliatory tariffs, secessions, dual governments, federalistic schemes, all directly or indirectly bear witness to the existence of the jealousy of states and nations. The mere citation of examples would take too much space; but this brief general reference may serve to indicate that jealousy is important for the social as well as individual life. An adequate philosophy of history or society cannot neglect this vital instinct.

IV. Summary.

1. Animal jealousy bears a close relation to anger and fear, and is a fundamental instinct, appearing in the lowest vertebrates and in the higher invertebrates. It is connected chiefly with feeding, mating and breeding, and serves as a corrective for the purely social instincts, thus protecting the individual as against the group.

2. Being phylogenetically so fundamental, jealousy appears

very early in the human. Its first manifestations are in regard to the maternal breast, but it continues into old age.

3. Jealousy is interpreted as a self-feeling, which depends for its content not only upon instinctive rivalry, but upon the influences of the social environment. Genetically the emotion shows important developments in complexity and refinement, as the sense of self deepens and expands. Childhood jealousy presents marked changes as compared with infancy. Puberty brings a special increment of sensitiveness.

4. The expression of the emotion exhibits changes, correspondingly. The infantile expressive movements are mainly overt, aggressive and highly instinctive in character. At adolescence, depressive, melancholic symptoms become frequent; they may be either subtle or severe.

5. An analysis of jealousy as a mental state proves it to be peculiarly complex and variable, and perhaps the most painful of all emotions. The commonest constituents are anger, grief and self-pity. The painfulness is due to the intense subjectivity of the psychosis, to the obstruction of impulses of pride and appropriation, to the disorganization of profoundly egocentric, and highly systematized ideas.

6. The pathology and criminology of jealousy reveal the tremendous practical importance of the instinct and the desirability of its further study especially in its non-morbid aspects.

7. The best pedagogy of jealousy for children and youth is probably indirect and preventive, and consists in the cultivation of a healthy personality sense.

8. Anthropology and the history of society demonstrate the significance of sexual jealousy for the family institution, for chastity, monogamy and conjugal fidelity.

9. The scope of jealousy is shown to be much wider than is ordinarily recognized. Jealousy is at the basis of many attitudes which the individual takes toward his fellows; it colors social customs and institutions; it motivates group action.

By way of acknowledgment I desire first to express my grateful indebtedness to President G. Stanley Hall for his helpful interest in the undertaking and the completion of this study. My indebtedness extends to others connected with Clark University, particularly to Dr. A. F. Chamberlain, Research Assistant Theodate L. Smith and Docent G. E. Partridge. I am under considerable obligation to Miss L. A. Williams, of Trenton, N. J., Normal; Miss M. K. Smith, of New Paltz, N. Y., Normal; Miss M. Prichard, of Philadelphia Normal, and to Dr. Walter Libby, of Northwestern University, for their co-operation in securing questionnaire data. For various friendly offices I wish to thank Mr. J. W. Harris, Mr. E. W. Coffin,

and Mr. Tadasu Misawa. I cannot mention many kind services, which were, however, especially appreciated because of the circumstances under which most of this thesis was prepared. Valuable and generous as all this assistance has been, I cannot help but realize the inadequacy and very preliminary character of the present study.

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MEMORY FOR LIFTED WEIGHTS.

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The object of the investigation was two-fold; on the one hand to study the influence of the interval upon the accuracy and quickness of recognition, and on the other to determine the mental processes involved in comparison and recognition. Lifted weights were used because they promised a domain where memorial images are very weak and would therefore shed light upon the place of the memorial image in recognition or comparison.

The results have, in a measure, at least, justified the expectation. As the historical side of the question has been pretty thoroughly covered in various articles, it seems advisable to omit in this connection further discussion of that, and to proceed at once to a description of the experiments, and an analysis of the data thus obtained. The experiments reported in this paper were begun in the fall of 1903 and continued without interruption until the middle of June of the following year.

EXPERIMENTAL.

The reaction times of the subjects were taken by means of a Hipp chronoscope, giving, on the average, readings which were correct to within 1.9σ. The subject was seated at a desk of convenient height, so that the right forearm rested comfortably upon it. The back of the hand rested upon a reaction key, which with a lip-key was used in the earlier experiments; but as it was found to be in many ways inconvenient, a Cattell speech key as modified by Walt was substituted and gave complete satisfaction. When the reagent lifted his hand from the reacting key, the circuit was completed through the chronoscope; and when he announced his judgment by speaking into the tube, the vibration of the disk broke the circuit, and in this way the total reaction-time was registered. The amount of flexion of the arm was regulated by a padded bar placed at a suitable height above the table, so that in lifting the weight, the wrist touched the bar.

A determination of the time taken in lifting the weights was made from time to time to see how constant its value was in the case of the different reagents: the mean variations range from 3% to 8% for the different subjects. When we compare these figures with the mean variations for the recognition-times

reported in the tables, it is evident that the control of lifting was relatively rigorous.

A series of eight Jastrow weights were used, ranging from a few grammes (20) up to a heavy weight of 600 grammes. Two of these, one of 250 gms. and the other of 225 gms. were kept constant thoughout the experiment, and furnished the weight intervals given in the tables. The weights were identical in shape and size consisting of hollow hard rubber cylinders, 4 inches long and 2 inches in diameter, which could be filled with a variable amount of shot kept from rattling by pads. The weights were kept out sight of the reagents by means of small screens, so that they remained in ignorance of the number of weights used. The "now" was given two seconds before the weight was placed by the experimenter in the hands of the reagent for lifting, and the time between the lifting of the norm and the stimulus of comparison was regulated by a stop-watch graduated to one-fifth of a second. The first weight lifted was taken as the norm, and the second weight as the stimulus, which was reported by the reagent to be "lighter," "equal," or "heavier" than the norm. For the standard intervals, the order of presenting the weights was reversed sometime during the experiment, as is the customary procedure to avoid constant errors. To reduce habituation to a minimum, the weights compared were chosen in irregular order; that is to say, the standard intervals which give the reaction times of the tables were interpolated between several other intervals. Calling the weights A, B, C, D, E, F, G, H, of which D and F, we will suppose, are the standards, we would have something like the following combinations in a typical experiment: B-C, *D-F*, G-H, *D-D*, *F-F*, C-H, *F-D*, *F-F*, etc.

The reagent, at the end of each comparison, gave an introspective account, as best he could, of the process of judgment. With some of the less experienced reagents, these reports were at first rather vague and confused; but soon each developed a terminology of his own that greatly abridged the task of recording the introspections. Out of this grew the classification of judgments used in table III. The reagents reported cases in which the norm and stimulus of comparison, were distinctly placed in a scale of values, or in which only one was thus carefully classified, with little or no reproduction of the sensations occasioned by the lifting of the norm. Here, of course, if any reliance is to be placed upon introspection, the central process is largely one of verbal supplementation. Other cases occurred in which the stimulus of comparison did not seem to have an absolute position assigned to it in the scale of weight values, but yet did have a position relative to the absolute position of the first. Both have been treated together in the tables under

the head of absolute judgments. In another class of judgments, along with the verbal supplementation, went a considerable amount of memorial image representation, in which the reagents assigned about equal importance to the two processes in the comparison of norm and stimulus. (It should be noted in passing that although the judgment in lifted weights is primarily directed to strain sensation, other sensations, in particular, visual, are integral parts of the mental activities involved, and with one exception, Mr. Freund, the visual memory of the arm movement was more predominant than the memory of the strain and pressure sensations.) Judgments of this type are reported as "mixed." In other instances, verbal supplementation played an insignificant rôle; the memory image in some form (visual, of arm movement, or motile, of pressure and strain) seemed clear enough to mediate comparison; such are recorded as "direct." One subject (Mr. Wright) furnishes a few judgments, sixteen, in which neither verbal supplementation nor the reproduction of memorial images was noticeable. The writer is inclined to regard these as of a negative character, due to inadequate or hasty introspection on the part of the reagent. They have been given a place as the fourth type of judgment under the denomination of "immediate."

The time intervals chosen for record were 20 secs., 30 secs. 40 secs., 50 secs., 60 secs., 80 secs., 100 secs., 120 secs. At first shorter intervals of 5 secs., and 10 secs. were used; but these were found on trial to be too short to permit the experimenter to perform his share of the work without some confusion and embarrassment. Now and then a longer time interval was interpolated, either in a blank experiment or in one desired for the introspective account. Each subject filled in the time between presentation of norm and stimulus with such mental occupation as he pleased.

Five subjects took part in the investigation: Dr. Pillsbury (P.), Mr. Galloway (G.), Mr. Wright (W.), Mr. Sherman (S.), Mr. Freund (F.) All except the last had had considerable training in laboratory work, the last, one semester's work in an introductory course.

Analysis of the Tables.

A. The Effect of the Memory Interval on the Time of Recognition. In the table below are given the average reaction times of all judgments taken together for the different intervals of time and for the whole eight intervals considered as a unit:

An inspection of the table fails to reveal the existence of a factor whose influence can be expressed in the definite mathematical fashion in which has been presented the time-course of the dissolution of a memorial image. We find for $\Delta = \pm 25$

TABLE I.

Average reaction times (r.t.), for the various memory intervals (t.i.), for the weight difference (△) of 25 ± gm and 0 gm, both right and wrong judgments taken together.

t. i.	20s.	30s.	40s.	50s.	60s.	80s.	100s.	120s.	Av.	No.
P.										
△ = ± 25 g. r.t.	1.292s	1.276s	1.152s	1.113s	1.189s	1.262s	1.285s	1.276s	1.228s	1067
△ = ± 0 g. r.t.	1.280s	1.223s	1.249	1.201	1.211	1.225	1.312	1.293	1.245	977
										2044
G.										
△ = ± 25 g. r.t.	1.007	1.004	.958	.942	.964	.980	1.013	.996	.983	812
△ = 1 0 g. r.t.	1.049	1.050	1.042	1.017	1.025	1.043	1.056	1.083	1.043	901
										1713
W.										
△ = ± 25 g. r.t.	.887	.803	.746	.780	.809	.819	.769	.839	.831	401
△ = 0 g.	.945	.762	.915	.797	.884	.853	.966	.938	.894	465
										866
S.										
△ = ± 25 g. r.t.	1.077	.983	.992	.935	.993	1.036	1.059	1.143	1.027	210
△ = 0 g. r.t.	1.098	1.083	1.158	.976	1.032	1.254	1.072	1.082	1.190	246
										456
F.										
△ = ± 25 g. r.t.	.702	.848	.850	.881	.908	.926	.683	.818	.838	141
△ = 0 g. r.t.	.781	.959	.818	.770	.895	.740	.826	.839	.829	157
										298

gm., that in the case of P., the reaction times decrease gradually from the 1st interval (1.292 s) on to the fourth (1.113 s) and then rise again more or less gradually during the remaining four intervals; in the case of G., essentially the same course is shown. The decline is from 1.007 s in the first to .942 s in the 4th, and the rise during the remaining four; in case of W., there is decline from .887 s in the first to .746 s in the third, with a steady rise to the end, with the exception of a drop to .769 s in the 7th; in case of S., a course somewhat irregular, but with the values higher for the latter intervals than for the earlier and with the minimum of .935 s in the 4th interval; in case of F. a still more irregular course, with a maximum of .926 s in the 6th interval and a minimum of .683 s in the 7th.

For △ = 0 gm., the general results are much the same. The reaction-time declines for P. from 1.280 s in the first to 1.201 s in the fourth, rising in a fairly gradual way during the last four intervals. G. shows an irregular decline from 1.049 s in the first to 1.017 s in the 4th., with a gradual rise during the remaining. In case of W., there is less regularity in the course

of the reaction time for this weight interval than for the other: The minimum of .762 s is reached in the 2nd interval, and the maximum of .915 s in the 4th, and then an irregular rise during the latter intervals. S. shows a gradual decline from 1.098 s in the first to .976 s in the 4th, and then an irregular rise during the latter intervals. F.'s course is irregular, the minimum of .770 s occurring in the 4th interval and the maximum of .959 s in the 2nd. The reaction times are in general higher for the difference $\Delta = 25 \pm$ gm., than for no difference. Taking the average of all the intervals, we have the following: P. 1.228 s for $\Delta = \pm 25$ gm., and 1.245 s for $\Delta = 0$ gm.; G., .983 s and 1.043 s resp.; W., .831 s and .894 s resp.; S., 1.027 s and 1.190 s resp.; F., .838 s and .829 s resp., the single exception to the statement.

The most, therefore, that we are entitled to say is, that there is gradual decline in the reaction time during the first 50 or 60 seconds, and then some increase for longer intervals of time. Fifty to sixty seconds seems to be the most favorable interval for judging the weights so far as the shortness of reaction can be taken to indicate this. This accords with what Prof. Angell found in his experiments on the discrimination of shades of gray for different intervals of time, though he did not extend them beyond 60 secs.[1]

The general statements just made are still further confirmed, on examining the values of the reaction time for right and wrong judgments treated separately, as will be seen by inspecting the following table:

Confining our attention at first to right judgments for $\Delta = \pm 25$ gm., we find that in case of P. the reaction time drops from 1.154 s in the first interval to 1.039 s in the third and rises in a fairly regular way to 1.189 s in the 8th; in case of G., a slightly irregular fall from .955 s in the 1st to .892 s in the 5th; with a somewhat higher level of values in the last three; in case of W., a decline, fairly regular, from .927 s in the 1st to .670 s in the 5th, and gradual rise during the last three to .729 s in the 8th; for S., an irregular fall from 1.010 s in the 1st to .803 s in the 4th, with higher values in the latter places; for F., an irregular course, with minima of .682 s in the 1st and .644 s in the 7th, and a maximum of .997 s in the 5th.

The average for wrong judgments for this weight difference shows a rough tendency to follow the same general course as do the right judgments. P's figures rise and fall till the 4th interval when a minimum of 1.177 s is reached, after which there is a fairly regular rise to 1.376 s in the 8th interval. About the same is true of G., who has a minimum of 1.046 s

[1] Phil. Studien, Vol. XIX, p. 19.

TABLE II.

Reaction Time in seconds for Right and Wrong Judgments. N. standard stimulus; V. stimulus of comparison; r. right and w. wrong judgments.

t. i.		20s.	30s.	40s.	50s.	60s.	80s.	100s.	120s.	Av.	No.
Dr. Pills.											
$\Delta = \pm 25$.											
r:	V ≷ N	1.154s	1.123s	1.039s	1.072s	1.131s	1.150s	1.200s	1.189s	1.135s	545
w:	V ≷ N; r.t.	1.286	1.342	1.240	1.140	1.270	1.366	1.368	1.351	1.298	293
	V ≡ N; r.t.	1.338	1.370	1.295	1.246	1.237	1.350	1.384	1.396	1.311	229
	Av.; r.t.	1.313	1.354	1.364	1.177	1.260	1.358	1.376	1.376	1.304	522
											1067
$\Delta = 0$											
r:	V ≡ N; r.t.	1.271	1.182	1.236	1.158	1.247	1.259	1.276	1.293	1.231	311
w:	V < N; r.t.	1.293	1.275	1.250	1.207	1.128	1.291	1.327	1.303	1.252	302
	V > N; r.t.	1.283	1.266	1.269	1.250	1.226	1.134	1.313	1.287	1.249	364
	Av.; r.t.	1.287	1.252	1.262	1.260	1.168	1.211	1.319	1.293	1.250	666–977
Mr. G.										grand	tot'l 2044
$\Delta = \pm 25$											
r:	V ≷ N; r.t.	.955	.874	.909	.896	.892	.928	.934	.903	.916	481
w:	V ≷ N; r.t.	1.069	1.085	1.046	1.040	1.054	1.070	1.137	1.067	1.074	145
	V ≡ N; r.t.	1.082	1.098	1.063	1.051	1.045	1.077	1.123	1.112	1.083	186
	Av.; r.t.	1.075	1.092	1.057	1.046	1.047	1.074	1.127	1.089	1.079	331
											812
$\Delta = 0$											
r:	V ≡ N; r.t.	1.041	1.048	1.037	.991	.983	1.030	1.047	1.057	1.029	309
w:	V < N; r.t.	1.070	1.053	1.042	1.029	1.047	1.044	1.057	1.062	1.052	294
	V > N; r.t.	1.044	1.048	1.054	1.041	1.056	1.052	1.060	1.058	1.051	298
	Av.; r.t.	1.057	1.050	1.048	1.036	1.052	1.048	1.058	1.068	1.052	592–901
Mr. W.										grand	tot'l 1713
$\Delta = \pm 25$.											
r:	V ≷ N; rt.	.927	.803	.677	.670	.703	.652	.694	.729	.709	230
w:	V ≷ N; rt.	.736	.921		1.307	.877	1.031	.818	1.133	.868	122
	V ≡ N; rt.	.949	.709	.832	.821	.968	1.174	.894	.937	.917	49
	Av.; rt.	.863	.803	.832	.967	.944	1.042	.819	1.014	.901	171
											401
$\Delta = 0$											
r:	r.t.	.892	.648	.763	.578	.741	.698	1.030	.964	.827	212
w:	V < N; r.t	.832	.901	1.183	.944	.988	.847	.994	.898	1.011	174
	V > N; r.t.	1.970	.696	.539	1.013	.889	.972	.728	.957	.812	79
	Av.; r.t.	1.060	.815	1.041	.965	.950	1.007	.892	.915	.967	253–465
Mr. S.										grand	total 866
$\Delta = \pm 25$.											
r:	V ≷ N; r.t.	1.010	.933	.969	.803	.660	1.070	1.039	1.016	.956	131
w:	Av.; r.t.	1.157	1.126	1.038	1.140	1.085	.992	1.078	1.148	1.118	79
											210
$\Delta = 0$											
r:	V ≡ N; r.t.	1.165	.688	1.214	1.161	1.154	1.167	1.207	1.118	1.027	97
w:	Av.; r.t.	1.015	1.165	1.108	.976	1.314	1.105	1.016	1.221	1.113	149–149
										grand	total 456

TABLE II.—*Continued.*

t. i.	20s.	30s.	40s.	50s.	60s.	80s.	100s.	120s.	Av.	No.
Mr. F.										
$\Delta = \pm 25$.	.682	.890	.819	.770	.997	.916	.644	.755	.817	72
r: $V \lesseqgtr N$;	.738	.838	.866	1.008	.785	.939	.721	.888	.845	69
w: } Av.; r.t.										141
$\Delta = 0$	.835	.938	.830	.716	.907	.782	.656	.887	.811	62
r: VIIIN;	.727	.977	.874	.809	.886	.717	.904	.807	.843	95–157
w: } Av.; r.t.										
									grand	total 298

in 4th, with a fairly regular ascent to 1.089 in the 8th; W. is irregular, with a minimum of .803 s in the 2nd, and a maximum 1.042 s in the 6th; S. shows a fall from 1.157 s in the 1st to 1.038 s in the 3rd, with an irregular course for the remaining intervals. For F, the course of values is irregular, varying from minima of .738 s and .785 s in the 1st and 5th to a maximum of 1.008 s in the 4th.

Of the wrong judgments, the class "$V \lesseqgtr N$" or "unlike" shows the following: P., a fairly regular descent from 1.286 s in the first to 1.140 in the 3rd, with an irregular ascent to 1.351 s in the 8th; G., a slight drop from 1.069 s in the first to 1.040 s in the 4th, with a slightly irregular course of higher values for the remaining intervals; W., an irregular course of values ranging from minima of .736 s and .818 s in the 1st and 7th, to a maximum of 1.307 s in the 4th.

The other class of wrong judgments, "VIIIN" or "like," yield similar results. We have in case of P., a fall from 1.338 s in the 1st to 1.237 in 5th, with a rise from 1.350 s in the 6th to 1.396 in the 8th; in case of G., a fall, a little irregular, from 1.082 s in the 1st to 1.045 s in 5th, with irregular higher values for the remaining three; in case of W., an irregular ascent from .803 s in the 2nd to 1.042 s in the 6th, with an irregular drop to 1.014 in 8th.

Taking the average for all the intervals, we see that right judgments are shorter on the whole than wrong judgments, being for the different reagents as follows: P., 1.135 s for right and 1.304 s for wrong; G., 1.231 s and 1.250 s, respectively; W., 709 s and 901 s, respectively; S., 956 s and 1.118 s, respectively; F., .817 s and 845 s, respectively; "VIIIN" or "like" judgments are longer than "unlike," "$V \lesseqgtr N$" judgments (P., 1.311 s and 1.298 s; G., 1.083 s and 1.074 s; W., .917 s and .868 s.)

Passing to the results tabulated for $\Delta = 0$ gm., in which norm and comparison stimuli are the same, we find about the same

things as we did for $\triangle = \pm 25$ gm., though the tendencies there noted are not so pronounced in the present instance. P.'s figures for right judgments fall irregularly from 1.271 s in the first to 1.158 s in the fourth, and then rise quite regularly during the rest of the intervals to a final of 1.293 s; G.'s results are similar to these, decline a little irregularly from 1.041 s in the first to .983 s in the 5th, with a small regular ascent to 1.057 in the 8th; W's course is irregular, with minima of .648 s in the 2nd, and .578 s in the 4th and a maximum of 1.030 s in the 7th. S.'s course is likewise irregular with a minimum of .988 s in the 2nd and a maximum of 1.207 s in the 8th. F. has a minima of .716 s in the 4th, after an irregular decline from .835 s in the 1st, with another minimum of .656 s in the 7th interval.

For the average of both classes of wrong judgments, we find for P., an irregular fall from 1.287 s in the 1st to 1.168 s, in the 5th, with an irregular rise to 1.293 s in the 8th; for G., a quite regular decline from 1.057 s in the 1st to 1.036 s in the 4th, with an irregular ascent to 1.068 s in the 8th; for W., an irregular course with a minimum of 815 s in the 2nd, and another of .892 s in the 7th and a maximum 1.007 s in the 6th; for S., an irregular fall to .976 s in the 4th, with irregular higher values in the latter intervals. For F., an irregular course with a minimum of .727 s in the 1st and another of .717 s in the 6th, and a maximum of .977 s in the 2nd and one of .907 in the 7th.

Of the two classes of wrong judgments, "V⟨N" give us for P. a fall, quite regular from 1.293 s in the 1st interval to 1.128 s 5th, with an abrupt, irregular ascent to 1.303 s in the 8th; for G, a fairly regular fall from 1.070 s in the 1st to 1.029 in the 4th, with a fairly regular rise to 1.062 in the 8th; for W., an irregular course of .832 s in the 1st and 847 s in the 6th as minima with a maximum of 1.183 s in the 3rd. "V⟩N" judgments give in case of P. a fall, regular, from 1.283 s in the 1st to 1.134 s in the 6th, with somewhat higher values in the remaining two intervals; for G., a rise and fall to a minimum of 1.041 in the 4th, and irregular higher values in the remaining four; for W., an irregular course with a minimum of .539 s in the 4th.

Comparing the averages for all eight intervals of time taken together we find again right judgments shorter than wrong: (P. 1.231 s and 1.250 resp.; G. .916 and 1.079 resp.; W. .827 s and .967 s resp.; S., 1.027 s and 1.113 s, resp.; F., .811 s. and .843 s resp.)

Of the two classes of wrong judgments, "V ⟨ N" are longer than "V ⟩ N" in case of P (1.25 s and 1.249 s resp.) about the same in case of G (1.052 s and 1.051 s resp.), longer for W (1.011 s and .812 s resp.)

Now for $\Delta = O$, "VIIIN" judgments are right judgments; and while as noted above these are shorter than wrong judgments, yet the peculiar nature of "like" judgments again is seen in the fact that relative to the wrong judgments the right for $\Delta = O$ are higher than for $\Delta = \pm$ 25 gm., the ratios being respectively as follows: P 1.01 and 1.15; G. 1.02 and 1.17; W, 1.17 and 1.27; S, 1.08 and 1.17.

The reaction times have also been calculated for the totals of the three classes of judgments which the introspective records developed, viz.: "absolute," "mixed" and "direct;" and the same are presented in the following table:

TABLE III.

Reaction Time in Relation to Nature of Judgment.

$\Delta = \pm$ 25 gm.

	Nature of Judgm't.		Right (V ≷ N)	Wrong. V ≷ N	Wrong. VIIIN	Wrong. Av.	Av. for all.
Dr. P.	Absolute;	rt.	1.098s	1.219s	1.262s	1.237s	1.153s
	Mixed;	"	1.187	1.356	1.340	1.351	1.279
	Direct;	"	1.119	1.300	1.364	1.320	1.256
Mr. G.	do	"	.864	.955	.937	.945	.940
	do	"	1.001	1.238	1.227	1.236	1.121
	do	"	.896	.983	1.086	1.048	1.024
Mr. W.	do	"	.668	.886	.789	.881	.755
	do	"	.725	1.017	1.122	1.055	.870
	do	"	.863	1.217	.918	1.045	.919
Mr. S.	do	"	.945			1.068	.974
	do	"	1.065			1.200	1.124
	do	"	.907			1.045	1.000

$\Delta = 0$ gm.

	Nature of Judgm't.		Right (VIIIN)	Wrong. V < N	Wrong. V > N	Wrong. Av.	Av. for all.
Dr. P.	Absolute;	rt.	1.212s	1.238s	1.242s	1.240s	1.229s
	Mixed;	"	1.258	1.268	1.250	1.259	1.261
	Direct;	"	1.225	1.228	1.259	1.248	1.241
Mr. G.	do	"	1.006	1.039	1.048	1.043	1.031
	do	"	1.050	1.067	1.056	1.062	1.058
	do	"	1.024	1.054	1.055	1.054	1.045
Mr. W.	do	"	.820	1.021	.920	.994	.928
	do	"	.726	1.103	.659	.912	.798
	do	"	.997	1.244	1.360	1.272	1.140
	Immediate	"	1.098			1.121	1.102
Mr. S.	do	"	1.110			1.165	1.142
	do	"	1.265			.951	1.048
	do	"	1.100			1.001	1.045

For $\triangle = \pm 25$ gm. we note that, both right and wrong judgments taken together, the reaction time of "the absolute" is the least, the distribution for the "absolute" "mixed" and "direct" is: P., 1.153 s, 1.279 s, and 1.256 s; G., .940 s, 1.121 s, 1.024 s; W, .755 s, .870 s, and .919 s; S, .974 s, 1.124 s, 1.000 s.

Right ("V ≶ N") absolute judgments are also less than right judgments of either "the mixed" or "direct" class, with one exception, S. with whom "direct" are shortest. Right judgments are also shorter than the average of both classes of wrong judgments. Thus in case of P., the reaction times in "absolute," "mixed" and "direct" respectively are for right judgments, 1.098 s, 1.187 s, and 1.119 s, and for wrong, 1.237 s, 1.351 s, 1.320 s; in case of G., .864 s, 1.001 s, and .896 s for right, and for wrong, .945 s, 1.236 s, 1.046 s; W., .668 s, .725 s and .863 s, for right, and .881 s, 1.055 s and 1.045 s for wrong; S, .945 s, 1.065 s and .907 s for right and 1.068 s, 1.200 s, 1.045 s. The "mixed" right and wrong judgments are the longest with one exception, W., for whom "direct" right judgments are the longest. This seems to indicate that a complication of memorial images with verbal supplementation interferes in a measure with the comparison of the normal stimulus, so far as reaction time can be taken to indicate anything in the matter.

Taking the average for both kinds of wrong judgments, we find in all cases the "mixed" to be the longest and with one exception (S.), the "absolute" to be the shortest, the results being as follows: P., 1.237 s, 1.351 s, and 1.320 s for "absolute," "mixed" and "direct" respectively; G., resp. .945 s, 1.236 s, 1.048 s; W., resp., .881 s, 1.055 s, 1.045 s; S., resp., 1.068 s, 1.200 s, 1.045 s.

For "V ≶ N" wrong judgments (unlike), we have in case of P., the absolute shortest (1.219 s) and the mixed longest (1.356 s); in case of G., the same ("absolute," .955 s and "mixed" 1.238 s); in case of W, the "absolute" shortest (.886 s) and "direct" longest (1.217 s).

The results show that for "VIIIN" wrong judgments (unlike) the absolute are in all cases the shortest, being for P., 1.262 s; for G., .937 s and for W., .789 s; and that in case of P., "direct" are longest (1.364 s), in case of G., "mixed" are longest (1.227 s), and in case of W., mixed are also longest (1.122 s).

The results tabulated for $\triangle = 0$ g. are on the whole like those for $\triangle = \pm 25$ gm., though less pronounced. Referring to the averages for all judgments (both right and wrong), we find the "absolute" to be the shortest with one exception W., and the "mixed" the longest with one exception W., the several values being these: P., "absolute," 1.229 s; "mixed,"

1.261 s; "direct," 1.241 s; G., resp. 1.031 s, 1.058 s, 1.045 s; W. .928 s, 798 s, 1.140 s resp.; S., 1.142 s, 1.048 s, 1.045 s, resp. And the values of the "absolute" judgments are on the whole higher for $\Delta = 0$ gm. than for $\Delta = \pm 25$ gm., though this relation does not hold true in case of "mixed" and "direct."

Of the right judgments ("VIIIN"), "the absolute" are with one exception (W.), the shortest, and with one exception (W.), the "mixed" are the longest. And the values of the right judgments are on the whole considerably higher there than they are for $\Delta = \pm 25$ gm.

Passing to the average of wrong judgments, we note that the "absolute" are shortest for P. and G., and the "direct" for W., and the absolute for S.

The "V⟨N" wrong judgments are shortest in case of the direct for P.; in case of the "absolute," for both G. and W. The longest of these judgments appears among the "mixed" for P. and G., and among the "direct" for W.

Of the "V⟩N" wrong judgments, the "absolute" are shortest for P. and G., and the "mixed" for W.; the direct are the longest for P. and W., and the "mixed" and "direct" about the same for G.

B. *Effect of Length of Memory Interval on Mean Variation.* The mean variations have been calculated for the various intervals and for total values, not only to obtain some idea of the trustworthiness of the data presented, but also to see if any additional light was thrown on the nature of the judgment-process itself. For these purposes the following table is annexed:

TABLE IV.

Relative Mean Variation $\left(\frac{m\,v}{v}\right)$ *in relation to the Time Interval.*

t. i.	20"	30	40	50	60	80	100	120	Av.
$\Delta = \pm 25$ gm.									
Dr. P.									
r: V⟩N	20+%	19+%	16+%	16—%	14+%	15+%	14+%	16+%	16+%
w: V⟨N	22+	23+	18+	18—	17+	17—	15+	21—	19+
w: VIIIN	23—	24+	21—	23+	19+	17+	16+	17+	24—
w: Av.	23—	23+	19+	19—	17+	17—	16—	15+	19—
Av. for r.+w.	19+	21+	17—	16+	15+	16+	16+	17—	15+
Mr. G.									
r: V⟩N	20—	17+	15+	16—	14+	13+	16+	14+	15+
w: V⟨N	21+	22+	20—	18+	17—	14+	16—	16—	18—
w: VIIIN	23+	18+	20—	21—	17+	16+	14+	12+	19+
w: Av.	22+	20—	20+	19+	18—	15+	15—	16+	20+
Av. for r.+w.	21+	18+	17+	19—	15—	13—	16+	14—	16+

TABLE IV.—*Continued.*

t. i.	20	30	40	50	60	80	100	120	Av.
Mr. S.									
r: V≷N	17+	14−	13—	15+	18—	18+	21+	19+	16—
w: V≤N									
w: VIIIN									
w: Av.	21+	22—	17—	15—	23—	20+	22—	20+	18+
Av. for r.+w.	18—	15—	14—	17+	20+	21—	11+	19+	17+
Mr. W.									
r: V≷N	17+	12—	20+	13+	13—	18+	13+	14+	14+
w: V≤N	13+	14—	12+	13+	9+	12+	10+	9+	13+
w: VIIIN	16—	12—	16+	18+	12—	14+	9+	13—	17+
w: Av.	9+	10+	12+	14+	10+	12+	10+	16+	14—
Av. for r.+w.	20+	11+	16+	15+	11+	18+	14—	15—	14—
Mr. F.									
r:	23—	16—	20+	23+	18+	15—	17—	19+	18+
w: V≤N									
w: VIIIN									
w: Av.	18—	19—	17+	16+	21—	19—	22+	20+	17—
Av. for r.+w.	22+	17+	19—	19+	20+	17—	21—	16+	19+
△ = 0 gm.									
Dr. P.									
r: VIIIN	23—	21+	20	17+	15+	17—	16+	15+	18+
w: V<N	21+	24—	20—	19+	17—	18—	19+	20—	19+
w: V>N	23+	21—	22—	18+	17+	19—	17+	16—	17+
w: Av.	23—	19+	21+	22—	18—	17+	19—	19+	20—
Av. for r.+w.	20—	22—	20+	20—	17—	18—	16+	18+	19+
Mr. G.									
r: VIIIN	20—	22+	21—	18+	16+	17+	15+	18—	19—
w: V<N	22+	21+	24—	20—	19—	21—	23+	22—	21+
w: V>N	19+	20—	23+	23—	10+	17+	20—	19—	19+
w: Av.	21—	20+	24—	21+	19+	19—	21—	20+	20—
Av. for r.+w.	20+	22—	20+	18+	16+	20—	21+	20—	18+
Mr. W.									
r: VIIIN	11—	25—	16+	12+	12+	16—	24+	10+	18—
w: V<N	10+	15+	14+	14+	16—	11—	12—	15+	13+
w: V>N	6—	11—	20—	10+	20—	—	15—	12+	18+
w: Av.	15+	14+	17+	13+	15+	15+	15+	12+	16—
Av. for r.+w.	13+	16+	18—	18+	16+	18+	18+	13+	17—
Mr. S.									
r: VIIIN	19+	22—	17—	15—	18—	16—	20+	19+	18—
w: V<N									
w: V>N									
w: Av.	18—	16+	20+	21+	19—	18+	17+	22—	20—
Av. for r.+w.	17+	18+	19+	21+	17—	21—	18+	18+	18+
Mr. F.									
r: VIIIN	16+	20+	22—	16+	15—	14—	19+	20+	18—
w: V<N									
w: V>N									
w: Av.	22—	17+	15+	20+	18+	21+	17—	16+	20—
Av. for r.+w.	18—	16+	18+	21—	17—	16+	21+	18—	17—

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$\Delta = \pm 25$ gm: For the two most important subjects, P. and G., there is, taking the average for all the intervals, less variation for right than for wrong judgments, and for S. the same is true; for W., the variation is equal in the two instance; for F. it is less in wrong judgments. Between the two classes of wrong judgments, "V $\gtrless$ N," and "V III N," the variation is less in the former than in the latter for the three reagents, P., G., and W. This result is taken to confirm the conclusion previously drawn from the reaction time of the two classes of wrong judgments. As noted before, "like" judgments have an element of uncertainty in them depending upon the absence of the criteria available in the other classes of judgments, with the consequence that they are not only longer, but also more variable.

As regards the relation between the different time intervals and their respective mean variations, no evidence is forthcoming of the influence of a factor having the definite relation to the time that the memorial image has been assumed to possess. For right judgments, we have in case of P. a fairly uniform drop from 20+% to 14+% during. the first five intervals, with an average above 14+% for the remaining three. This follows closely the relation between reaction time and the time brought out in table I, the minimum being 1.113s for the 4th interval (50 sec.). For G., we have a more or less constant decline from 20—% to 13+%, during the first six intervals, and a higher average for the remaining two. We have here again a close parallel to the course of the reaction time, though it should be noted that the minimum reaction time is reached two intervals earlier (in the 4th). For W., no definite tendency is apparent, the minimum of 12—% occurs in the 2nd interval and the maximum of 20+% in the third. For S., there is a decline from 17+% to 13—%, during the first three intervals, with an irregular higher level maintained during the remaining five. In case of F., the course is irregular throughout, with a minimum of 15—% in the 5th interval and a maximum of 23+% in the 4th.

Taking both classes of wrong judgments together, we find there is a fairly regular decline in case of P. from 23—% in the 1st to 15+% in the last; in case of G., a fall from 22+% to 18—% during the first five, and a somewhat lower level for the remaining three; for W. a gradual increase from 9+% to 14—% in the first four, and an irregular course for the last four; for S, an irregular decline from 21+% in the 1st to 15—% in the 4th, with a considerably higher level for the remainder; for F., the course is irregular throughout.

Of the two classes of wrong judgments, "V $\gtrless$ N" judgments ("unlike" judgments) yields the following results: For

P. there is a more or less graded decline from 22+% to 15+% during the first seven intervals, with a sudden jump to 21—% in the 8th; for G. there is a level of about 20% for the first three, a decline from 18+% to 14+% in the next three, and a level of about 16% for the last two; for W., the course is irregular, values ranging from a minimum of 9+% in the 5th, to a maximum of 14—% in the 2nd; for S. and F., wrong judgments have not been separated into the two classes, because the number of cases was thought too small. The other class of wrong judgments, "VIIIN" or "like" judgments, furnishes the following: for P., the course maintains a level of about 23% during the first four intervals, with a gradual drop from 19+% to 16+% during the next three, and a jump to 19+ in the 8th; for G., there is during the first four a fairly constant level of about 20% with a fairly regular decline from 17+% to 12+% during the last four; for W., the course is irregular as in the case of the other class of wrong judgments, though the average is somewhat higher (17+% as against 13+%). The net result of the foregoing, so far as wrong judgments are concerned, is that no influence capable of a precise mathematical formulation is observable, though for the two most important reagents, P. and G., we are entitled to say that the mean variation is higher for the earlier intervals, though in the 8th interval high values again appear in P.'s case.

Taking the averages for both right and wrong judgments, we have in case of P., a level of about 20% during the first two intervals, and slight variation around 16% during the other six; in case of G., an irregular decline from 21% in the first to 13—% in the 6th, with a drop from 16+% to 14—% in the last two; in case of W., an irregular course, with values ranging from a maximum of 20+% in the first to a minimum of 11+% in both the 2nd and the 4th; for S., an irregular course with a maximum of 20+% in the 5th interval and a minimum of 11+ in the 7th; for F., an irregular course with values higher in the latter intervals.

$\Delta = 0$ gm. In the case of right judgments, which for this increment are "VIIIN" judgments, we note the following: P.'s results follow the same general law as in the interval of $\Delta = \pm 25$, viz., a fairly uniform decline from 23—% in the first interval to 15+ in the 5th, and G., the same, the values for both reagents being higher than the corresponding values for $\Delta = \pm 25$; W.'s results are again irregular throughout, ranging from minimum of 11—% in the first and 10+% in the 8th, to a maximum of 25—% in the 2nd and 24+% in the 7th, with an average variation for the eight intervals of 18—%; S. shows an irregular decline from 19+% in the first to 15—% in the 4th, and an irregular course of higher values beyond this; F. has irregular

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maximum values in the first three and last two intervals, and considerably smaller minimum values for the middle intervals. On the whole the peculiar nature of "VIIIN" judgments is again manifest in the higher relative mean variations.

Taking both classes of wrong judgments (V⟨N and V⟩N) together, we find that the average mean variation for the eight intervals is higher than the corresponding mean variations for right judgments in the case of P. (20—% and 18+%), higher in case of G. (20—% 19—%), less in case of W. (16--% and 18—%), higher in case of S. (20—% and 18—%), higher in case of F. (20—% and 18—%). Comparing these results with the corresponding ones for $\Delta = \pm$ 25 gm., we get the following: P.'s results are about the same (20—% and 19—); so likewise G.'s (20—% and 19—%); W. higher for $\Delta = O$ (16% and —14%); S. higher for $\Delta = O$ (20—% and 18+); F. higher for $\Delta = O$ (20—% and 17—%). By comparing the two weights intervals in respect to the average variation for all judgments taken together, the following results appear: P. is more accurate for $\Delta = \pm$ 25 gm. (15+% and 19+%); G. the same as P. (16+% and .18+%); W. is equally accurate in both intervals (14—%). S. is more accurate for $\Delta = \pm$ 25 gm. (17+% 18+%); F., about the same for both (19+ and 19—). On the whole, therefore, the reagents show greater constancy for the larger weight intervals.

Of the two classes of wrong judgments, "V⟨N" and "V⟩IV," neither show very decided tendencies. With P. there is for "V⟨IV" judgments a drop from 21+% and 24%— respectively in the first two, to 17— in the 5th and then a gradual rise to 20 —% in the 8th, and for "V⟩IV" judgments an irregular fall from 23+% in the 1st to 17+ in the 5th, and a drop from 19—% in the 6th to 16— in the 8th; in case of G., "V⟨N" judgments have an irregular course, giving values ranging from 19—% in the 5th to 24—% in the 3d, "V⟩N" judgments likewise irregular with a minimum of 17+% in the 6th and a maximum of 23+ in the 3d; for W., "V⟨N" judgments are irregular, with values ranging from 10+% in the 1st, to 16—% in the 6th, while "V⟩N" have a lower minimum of 6—% in the 1st and a higher maximum of 20—% in the 3rd and 5th. Taking the mean variation for the full eight intervals we find the mean variation of "V⟨N" judgments higher than the mean variation of "V⟩N" judgments in case of P. (19+% and 17+%), higher in case of G. (21+% and 19+%), less in case of W. (13+% and 18+%).

The results for the mean variations of both right and wrong judgments taken together are these: P.'s figures follow the tendency noted for $\Delta = \pm 25$ gm, of declining to a minimum in the fifth interval with a slight rise for the remaining three intervals; though the tendency is less obvious, we have the

same general features in the course G.'s figures; while with the remaining three reagents the course is irregular throughout. The mean variation for the 8 intervals considered as a whole is higher for $\triangle = 0$ gm. than for $\triangle = \pm$ 25 gm, in case of P. (19+% and 15+%), G. (18+% and 16+%), W., (17—% and 14—%), and S. (18+% and 17+%), but the opposite for F. (19+% and 17%).

The mean variations have also been calculated for the totals of the three different classes of judgments, "absolute," "mixed," and "direct," and are embodied in the following table.

TABLE V.

Relative Mean Variation $\left(\frac{m\,v}{v}\right)$ *for the different kinds of Judgments.*

$\triangle = \pm$ 25 gm.

Nature of Judgment.	Re-agents.	Right $V \gtrless N$	Wrong. $V \leqslant N$	Wrong. $V^{m} N$	Wrong. Av.	Av. for all.
Absolute,	Dr. P.	15+%	19—%	20—%	18+%	17+%
Mixed,		17—	21+	24—	22+	21—
Direct,		18—	22+	18+	21+	20+
do	Mr. G.	16—	17+	19+	18—	17—
do		17+	18+	21+	20—	18+
do		15+	20—	18+	19+	17+
do	Mr. W.	15—	12+	15—	12+	12+
do		16—	12+	—	11—	16+
do		18+	—	—	20+	19+
do	Mr. S.	15+			17—	18—
do		18+			24—	20+
do		16+			18—	17+

$\triangle = 0$ gm.

	Reag'ts	Right $V^{m} N$	Wrong. $V < N$	Wrong. $V > N$	Wrong. Av.	Av. for all.
Absolute,	Dr. P.	17—	19—	20+	21—	18+
Mixed,		19+	21+	22—	18+	20+
Direct,		24+	15+	18—	16+	17—
do	Mr. G.	18+	18+	21—	20—	20+
do		19+	20—	21—	18+	19+
do		21+	24—	20+	22—	22+
do	Mr. W.	15+	14—	16+	15—	16+
do		18+	12+	8+	18+	19+
do		18+	—	—	11+	15+
do	Mr. S.	17—			18+	16—
do		19+			23+	21—
do		18+			13—	16—

The figures recorded above agree quite closely in their import with those given in the preceding table. For $\triangle = \pm 25$ we find that right judgments are on the whole less variable

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than wrong judgments. Thus in P.'s case the variation is 15+, 17—%, 18—% for right judgments, against 18+%, 22 +%, 21+% respectively for wrong judgments; G., 16—%, 17+%, 15+%, against 18—%, 20—%, 19+%, respectively; S., 15+, 18+, 16+, against 17—%, 24—%, 18—%; but in case of W. the values are anomalous, being 15—%, 16 —%, 18%, against respectively, 12+%, 11—%, 20+%. Between the two classes of wrong judgments, "VIIIN" (like) judgments show higher values as a rule than "V ≶ N" (unlike) judgments, being for P., 20—% to 19—%, 24—% to 21+ %, 18+% to 22+%; for G. 19+% to 17+%, 21+% to 18+%, 18 +% to 20—%; for W., 15—% to 12+%. Right "absolute" judgments show as a rule least variation as compared with other right judgments: thus for "absolute" right judgments the mean variation is 15%+; for mixed, 17—%; for direct, 18—% in case of P.; 16—%, 17+%, and 15+ respectively in case of G.; 15—%, 16—%, 18+% in case of W.; 15+%, 18+%, 16+% in case of S. The exception here of 15+ % for "direct" judgments in case of G., does not invalidate the general statement, for the number of direct judgments is comparatively small.

Of wrong judgments, the "unlike," "V ≷ N," follow the same general rule; for P., "absolute" have a mean variation of 19—%; "mixed," 21+%; "direct," 22+%; for G., 17+%, 18+%, 20—% respectively; but the other class of wrong judgments, "VIIIN" (like) is anomalous, the results being: P., "absolute" 20—%; "mixed," 24—%; "direct," 18%; G., "absolute," 19+%; "mixed," 21+%; "direct," 18+%, though it should be noted that in both instances, the mixed judgments have a higher mean variation than the absolute.

The interval $\Delta = 0$ gm. shows less decided tendencies than the interval $\Delta = \pm 25$, just discussed. Right judgments are not on the whole less variable than wrong: thus for P., we have for right judgments, 17—%, 19+%, 24+%, against 21—% 18+%, +16% for wrong; in case of G., 18+%, 19+%, 21+%, for right against 20—%, 18+%, 22—% resp., for wrong; in case of W., 15+%, 18+%, 18+% for right against 20—%, 18+%, 22—% resp., for wrong; in case of S., 17% 19+%, 18+%, for right judgments against 15—%, 18+%, 11+%, resp., for wrong judgments. Comparing the different kinds of judgments, we find consistent results among the right judgments. The mean variations are respectively 17—%, 19+%, 24+%, for the "absolute," "mixed," and "direct" in case of P.; 18+%, 19+%, 21+% resp., in case of G.; 15+%, 18+%, 18+% resp., in case of W.; and 17—%, 19+%, 18+% in case of S. As compared with the corresponding values for the difference of $\Delta = \pm 25$ gm., the results are somewhat higher, bringing to light again the peculiar nature of "like" judgments ("VIIIN").

Taking the totals for the different classes of judgments, we find the mean variation to be less for "absolute" judgments than it is for "mixed" with one exception, G.; the value being P. 18+% and 20+% resp.; for G., 20+% and 19+resp.; for W., 16+%, and 19+%, resp.; for S., 16—%, and 21 —% resp.

C. *Effect of Memory Interval upon the Percentage of Right and Wrong Judgment.* Herewith are appended the results obtained under the above head.

TABLE VI.

Percentage of Right and Wrong Judgments for the different intervals of time.

t. i.	20	30	40	50	60	80	100	120	Percentage of all judgments.
△ ± 25 gm.									
Dr. P.									
r. V≷N	42	34—	63—	61+	52—	46+	52—	53+	51+
w. V≶N	30	38—	19—	26—	34+	33—	22+	19—	27—
w. V=N	28	28+	18+	13+	14+	21—	26—	26—	22—
Mr. G.									
do	57—	53—	67—	69+	53+	64+	58+	49+	59+
w, do	20+	21—	12+	15+	15—	16+	17+	26+	18—
w, do	23—	26+	21+	16—	32—	19—	24+	24+	23—
Mr. W.									
do	37+	60—	56—	63—	56—	57+	56—	61—	58—
do do	37+	22+	44+	26—	32+	32+	26—	25—	30+
do do	25—	18+		11+	12—	11—	18+	14+	12+
Mr. S.									
do	73+	74+	70+	61+	62+	57—	50	45+	63+
do do	27—	26—	9—	39—	38—	43+	50	55—	37—
△ = 0 gm.									
Mr. G.									
r. V=N	49+	38+	53—	41+	39—	27—	23+	15—	34+
w. V<N	27+	35+	21+	26—	30+	32—	36—	48+	33—
w. V>N	24—	27—	26+	33+	31+	41+	41—	37+	33+
Dr. P.									
do	45	41	50	37+	32+	29+	18—	9+	32—
do do	21	21—	24+	29—	34—	35—	41—	36+	11—
do do	30	38+	25+	34+	34+	36+	41+	55+	37+
Mr. W.									
do	69	31+	49—	33+	31+	50	53+	46+	46—
do do	25	39—	40+	40—	41—	40	28+	38+	37+
do do	6	30+	11+	17—	28—	10	18+	15+	17+
Mr. S.									
do	52—	45—	48+	33+	37+	36+	35	35+	39+
do do	48+	55+	42—	67—	62+	64—	65	65—	61—

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The percentage of right cases does not seem to follow any very definite tendency in relation to the time interval. P.'s result shows an irregular rise from 42% in the first interval to 63—% and 61+% in the 3rd and 4th respectively, with a fairly level of course values of about 10% less for the remaining intervals. G. shows much the same thing; beginning with 57—% in the first interval and rising 67—% and 69% in the 3rd and 4th, with a rise and fall of lesser values to a minimum of 49+ in the 8th. W. begins with 37+% in the first interval and rises irregularly to 63—% in the 4th, and then has a course of values ranging between 56—% and 61—% in the remaining four intervals. In case of S., we have after the first two intervals, a fairly regular decline to 45+% in the eighth.

Comparing the two classes of wrong judgments with each other, we find in case of P. the percentage of wrong judgments on the whole higher for the "V ≶ N" or unlike, than for "VIIIN" or like, the opposite of this in case of G. but the same in case of W.

For $\Delta = 0$ we note the following results. With right judgments, which in this instance are "like," we have in case of P., the maximum of 50% in the third interval with a fairly regular decline during the remaining intervals to a minimum of 9+ in the 8th; in case of G., a maximum of 53—% in the third, and a fairly regular fall thereafter to 15—% in the 8th; in case of W., an irregular course, beginning with a maximum of 69—% in the 1st and falling to 31+% in the 2nd and again to 31+% in the 5th; in case of S. an irregular decline from 52+% in the 1st to 35+% in the 8th. The percentage of right judgments is on the whole less for $\Delta = 0$ than for $\Delta = \pm 25$ gm.

Of the two class of wrong judgments, the "V ⟩ N" show a higher percentage than the others in case of P. (37+% and 11—% respectively), about the same in case of G (33— and 33+ resp.), and a lower percentage in case of W (17 + and 37+ resp).

In the following table will be found the distribution of the percentage of right judgments for the different intervals of time among the "absolute," "mixed," and "direct" in case of P. and G.

From the above table we see that in case of P. for $\Delta = \pm 25$ gm., 57—% all right judgments are "absolute," *i. e.*, those in which comparison is mediated by verbal supplementation, while only 2—% are "direct," *i. e.*, those in which there is an evident reproduction of memorial images with little or no classification of the weights. Likewise for G., 60+% all right judgments are "absolute," while only 2+% are "direct."

Comparing the different time intervals, we find a fairly regular increase in the percentage of right judgments in case of P.

51—% of P.'s judgments "absolute" and only 10+% of them "direct," and 48—% of G.'s "absolute" and 11—% "direct."

The percentage totals for the eight intervals of time taken together, which are given below, present some very interesting results in respect to the distribution of right and wrong judgment within each class.

TABLE VIII.

Percentage Totals of the eight Intervals of Time taken together for the different classes and kinds of Judgment.

$\Delta = \pm$ 25 gm.

Re-agent.	Nature of Judgment.	Percentage of Right $V \gtrless N$	Wrong. $V \lesseqgtr N$	$V^{III} N$	All judgments of each reagent.
Mr. G.	Absolute,	67—	18—	17+	53—
	No.	290	67	73	430
	Mixed,	56+	19—	25+	39+
	No.	181	59	81	321
	Direct,	16+	31+	53+	8—
	No.	10	19	32	61
Dr. P.	Absolute,	60—	24—	16+	49—
	No.	312	123	86	521
	Mixed,	43+	30+	27—	48+
	No.	224	157	137	518
	Direct,	32+	46+	22—	3—
	No.	9	13	6	28
Mr. W.	Absolute,	57+	32+	11—	79+
	No.	182	102	34	318
	Mixed,	56	28	16	12+
	No.	27	15	8	50
	Direct,	56+	19—	25—	8+
	No.	18	6	8	32
	Immediate,	1—			1—
	No.	2			2
Mr. S.	Absolute,	77—	23+		60—
	No.	96		29	125
	Mixed,	45+	54—		26+
	No.	25		40	55
	Direct,	33+	67—		14+
	No.	10		20	30

$\Delta = 0$ gm.

Re-agent.	Nature of Judgment.	Percentage of Right $V^{III} N$	Wrong. $V < N$	$V > N$	All judgments of each reagent.
Dr. P.	Absolute,	38—	30+	20+	43—
	No.	158	126	135	419
	Mixed,	27—	33—	40+	46+
	No.	121	148	184	453
	Direct,	30+	27—	43—	11—
	No.	32	28	45	105

TABLE VII.

Percentage of Right Judgments for the different Intervals of Time in the "Absolute," "Mixed" and "Direct" classes.

t. i.		20	30	40	50	60	80	100	120	Total.
Dr. P.										
$\Delta = \pm$ 25 gm.										
Absolute,		40+	46—	51—	54—	58+	61—	69—	68—	57—
	No.	17	17	43	49	38	43	55	50	312
Mixed,		55—	49—	46—	44—	41+	39+	31+	32+	41—
	No.	23	18	39	40	27	28	25	24	224
Direct,		5—	5+	3+	2+	0	0	0	0	2—
	No.	2	2	3	2	0	0	0	0	9
$\Delta = 0$ g.										
Absolute,		38+	39+	41—	54+	61—	63—	61—	64+	51—
	No.	16	18	20	25	28	30	14	7	158
Mixed,		50	48—	43—	28+	33+	35—	35—	36—	39—
	No.	21	22	21	13	15	17	8	4	121
Direct,		12—	13+	16+	17+	6—	2+	4+	0	10+
	No.	5	6	8	8	3	1	1	0	32
Mr. G.										
$\Delta = \pm$ 25 gm.										
Absolute,		49—	52	50	51—	62+	69—	71—	79+	60+
	No.	22	26	32	42	29	46	51	42	290
Mixed,		44+	44	45+	47—	38+	31+	29+	21—	38—
	No.	20	22	29	39	18	21	21	11	181
Direct,		7—	4	5+	2+	0	0	0	0	2+
	No,	3	2	3	2	0	0	0	0	10
$\Delta = 0$										
Absolute,		47—	43—	43+	46+	48—	49—	57+	64—	48—
	No.	21	18	23	18	23	19	12	14	148
Mixed,		44+	48—	43+	36—	37+	38+	43—	36+	41+
	No.	20	20	23	14	18	15	9	8	127
Direct,		9—	9+	13+	18—	15—	13—	0	0	11+
	No.	4	4	7	7	7	5	0	0	34

from 40+% in the first interval to 68—% in the 8th. Further, the "direct" judgment are found only in the earlier intervals. So too with G., there is an increase from 49—% in the first to 79+% in the 8th, and as with P., the direct judgments are found in the earlier intervals.

For $\Delta = 0$, the general trend is the same. P.'s results show an increase from 38+% to 64+% in "absolute" judgments in going from 1st to 8th interval, with the greater part of the "direct" judgments in the earlier intervals. G. increases irregularly from 47% in the first interval to 64—% in the 8th in the absolute judgment, and has most of the direct judgments in the earlier intervals. Passing to the totals, we find

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39—% "mixed," and but 12+% direct; W., 77—% "absolute," 15+% "mixed," 5+, "direct," 3+% nondescript or immediate; S., 75+%, "absolute," 16—% "mixed" and 9—% "direct."

2nd. Taking the different kinds of judgments, P has 38-%, the "absolute" right, 27—% of the "mixed" right, and 30% "direct" right; G. has 34—% of the "absolute" right; 36+% the "mixed" right, and 30+% the "direct" right; W. has 42—% the "absolute" right, 61+% of the "mixed right," 50% of the "direct" right; S. has 41—% of the "absolute" right, 31—% of the "mixed" right and 45—% of the "direct" right.

3d. Of the two classes of wrong judgments, the percentage runs higher on the whole for "V ⟩ N" judgments in case of both P. and G., with the opposite relation for W. There are some miscellaneous facts related to the above which it is necessary to put into tabular form. The distinction of right judgments among the different kinds of judgments is as follows: $\Delta = \pm$ 25 gm., P. has 57+ "absolute," 41—% "mixed," and 2—% direct; G. has 60+% "absolute," 38—% "mixed" and 2+% direct; W. has 71+% absolute, 12—% "mixed" and 8—% "direct;" S. has 73+% "absolute," 19+% mixed and 8—% direct. For $\Delta = 0$ gm, 51+% of right judgments are "absolute," 39—% "mixed," 10+ "direct" in case of P.; 48% absolute, 41% "mixed" and 11% "direct" in case of G.; 70—% absolute, 21+% "mixed" 5+% "direct," and 4—% "immediate" in case of W.; 77+% "absolute," 12+% "mixed," 10+ "direct" in case of S.

Summary of Results.

1. The larger portion of the judgments are absolute, *i.e.*, those in which verbal supplementation is the most conspicuous part of the judgment process. This agrees with the conclusions reached by Prof. Angell in his experiments on the discrimination of shades of gray.[1]

2. There is a correlation between correctness of judgments, length of time in making the judgment, and the relative mean variation. There is a decrease in the length of the reaction, in the extent of the mean variation and an increase in the percentage of right judgments during the earlier intervals, clearly indicated in the case of the reagents, Dr. Pillsbury and Mr. Galloway, who have furnished over three-fourths of the judgments recorded. The interval of 40 to 60 secs. seems the most favorable for the judgments, so far as this is indicated by maximum percentage of right cases, minimum length of reaction time and mean variation. These results thus indicate some fundamental change in condition for judgments made with a longer interval between presentation of norm and comparison stimulus. Prof. Angell also found in the experiments above noted, that

[1] Philos. Stud., Vol. 19, p. 21.

TABLE VIII.—*Continued.*

Re-agent.	Nature of Judgments.	Percentage of Right VIIIN	Wrong. V < N	Wrong. V > N	All judgments of each reagent.
Mr. G.	Absolute,	34—	35—	31+	49—
	No.	148	153	137	438
	Mixed,	36—	30+	34—	39—
	No.	127	106	116	350
	Direct,	30+	31—	39—	12+
	No.	34	35	44	113
Mr. G.	Absolute,	42—	42+	16	77—
	No.	148	150	58	356
	Mixed,	61+	22+	17—	15+
	No.	44	16	12	72
	Direct,	50	33+	17—	5+
	No.	12	8	4	24
	Immediate,	57+		43—	3+
	No.	8		6	14
Mr. S.	Absolute,	41—	59+		75+
	No.	75	110		185
	Mixed,	31—	69+		16—
	No.	12	27		39
	Direct,	45—	55+		9—
	No.	10	12		22

For the difference of ±25 gm. we find in case of P. 49—% of all his judgments are "absolute," 48+% "mixed," and only 3—% "direct;" in case of G., 53—% of all judgments are "absolute," 39+ "mixed" and but 8—% "direct;" in case of W., 79+% "absolute," 12+% "mixed," 8+% "direct;" in case of S. 60—% are absolute, 26+% "mixed," and 14+% "direct." The distribution of right and wrong judgments is this: for G., 67—% of all "absolute" judgments, 56+% of all "mixed" judgments, and 16+% of all "direct" judgments are right; for P., 60—% of all "absolute," 43+% of all "mixed," and 32+ of all "direct" judgments are right; for W., 57+% of all "absolute," 56% of all "mixed," 56+% of all "direct" judgments are right; in case of S., 77—% of all "absolute," 45+% of all "mixed," and 33+% of all direct are right.

The distribution of wrong judgments between the two classes of "like" (VIIIN) and "unlike" (V≷N), does not follow any law for the different reagents. P. has more "unlike" than "like;" G. has more "like" for "mixed" and "direct," and about the same number of "like" and "unlike" for absolute judgments. W. has more "unlike" for "absolute" and "mixed" and more "like" for direct judgments.

For $\Delta = 0$, we have the following percentages: 1st taking all the judgments of each reagent, P., 43—% "absolute," 46% "mixed" and only 11—% direct; G., 49—%, "absolute,"

the reaction was shortest for 60 secs., the longest interval investigated; and explains the fact as due to a change in sensory conditions. He writes in the article already referred to: "as regards the reactions for 5 secs. it has been observed that the demeanor of the reagents for the shorter intervals, is commonly, though not invariably, different from what it is in the longer In the 30 and 60 sec. intervals, the reagent is apt, soon after the exposure of the norm, to relax the trunk muscles, settle himself in an easy attitude, to breath easily and to move the eyes from time to time over the background. During the shorter periods, as has already been observed, the reagents usually try to maintain uniform sensory conditions for both norm and comparison; the tension sensation from trunk, respiration and eye muscles are kept constant in order apparently to make the conditions of comparison as much alike as possible. Accordingly we have, for most reagents, a much larger mass of background of sensation entering into the comparison of shorter intervals, and in all probability more genuine acts of comparison."[1] I have made no records touching on the demeanor of the reagents for the various intervals; but there is a fact reported in the preceding part of this paper, which confirms the statements made in the above quotation, viz., that the percentage of absolute judgments increases in the longer intervals, while the direct judgments are relatively most numerous in the shorter intervals.

3. "Like" judgments are of a negative character, that is, such as the reagents make when the criteria of the other judgments are absent. There is an uncertainty in making judgments of this sort, which shows itself especially in a lengthened reaction time and often in a higher mean variation.

4. Right judgments are, as a rule, shorter, less variable than wrong judgments, the more so when there is a difference between norm and stimulus of comparison.

5. Absolute judgments are shorter and less variable than other kinds, and the percentage of them increases in the longer intervals. Frequently the memorial image acts as disturbing factor, as is seen in the fact that in many instances the "mixed" judgments are longer than either the absolute or direct.

6. The images are, according to the introspective reports of the reagents, more visual, or at least as much so, as they are motile. The sensations aroused by lifting weights are a complex of visual and kinæsthetic elements, of which the visual function the more conspicuously in the judgment process. When this is direct, that is a comparison between the sensations peripherally aroused by the stimulus of comparison, and the memorial image of the norm.

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[1] Philos. Stud., Vol. XIX, p. 18.

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7. There is an evident loss of sensory memory with the flow of time, if by that we mean a higher percentage of errors for the longer intervals of time (beyond 30 to 60 seconds) and a lengthened time of reaction.

8. The general trend of the results is that in judging the comparative magnitude of lifted weights, the most important thing concerned in the process is not a memorial image undergoing a progressive decay that bears a definite mathematical relation to the time as measured by the amount of work necessary to restore it to its former integrity.

Brief Statement of Theory of the Judgment of Lifted Weights.

All reagents reported the immediate disappearance from consciousness of the memorial image, when present, as soon as the lifting of the second weight began; so that a direct comparison between the memorial image and the sensations aroused by the second weight in a way at all analogous to the comparison of two peripherally aroused sensations occupying consciousness simultaneously or nearly so, was out of the question. Besides, in these cases where the reagents were unable to pass any judgment whatever, because the norm had been completely forgotten, it was found that the failure was invariably due to an inability to reproduce the verbal supplement of "light" "heavy," etc., which served to place the norm in a scale of weight values. The classification of the norm enables the reagent to adjust the muscles for the lifting of the second weights or stimulus of comparison to a degree determined by the intensity of the strain sensation resulting from the adjustment. If this adjustment is just sufficient to lift the second weight with the usual degree of ease and rapidity, the norm and stimulus are felt to be equal; if the adjustment more than suffices, the second weight flies up more quickly than usual, and seems lighter; on the other hand, if the adjustment is insufficient, the weight does not move, a fresh innervation is made, the feeling of effort is correspondingly great, and the stimulus of comparison seems heavier. The judgment results from changes in a complex of peripherally aroused sensations, and not from a comparison between a peripherally aroused sensation and a copy of the same in the form of a memorial image. This theory is substantially that of Müller and Schuman.[1] with the exception of the part played by the "motor" image, The impulse to adjustment is largely a verbal idea, which gives a position to the weight in a scale of values.

[1] Müller and Schuman, Pflüger's Archiv, für Physiologie, 1889, Vol. 45, pp. 55 ff. Martin and Müller, Zur Analyse der Unterschiedsempfindlichkeit, Experimentale Beiträge, J. A. Barth, Leipzig, 1899, pp. 206 ff.

ORGANIC CHANGES AND FEELING.[1]

By JOHN F. SHEPARD, Ph. D.

The experimental work here reported was begun in the early part of November, 1903, and was continued until January, 1906, with omission of the summer vacations. The intention at the start was to test the organic reactions accompanying various mental processes, with special reference to Wundt's tridimensional theory of feelings, and this object has been kept in mind throughout. To this end the subjects were asked to give a careful account of the conscious factors involved, and to note particularly to what extent they might be called excitement or repose, strain or relaxation, agreeableness or disagreeableness. There certainly are such processes, whatever their character as feeling or sensation may be, whatever may be the physiological changes accompanying them, and these two points must be kept partly separate for the present. Some attempt will be made to determine more definitely with what kinds of processes we are dealing, but the success or failure of this attempt cannot destroy the value of the work on the organic reactions.

The possible expressive processes studied were the change in the volume of the hand; in the volume of the brain; in the heart rate; and to some extent depth and rate of breathing and the form and size of the plethysmographic pulse in brain and hand. The disagreement among the writers on the subject is so great that no estimate can be made of the present status of the problem except by a brief abstract of the recent literature, and to this I now turn.

It is needless to review the writings treated by Angell and Thompson in their article on "Organic Processes and Consciousness." It would be difficult to do it again so well. I can begin with a statement of the results obtained by these authors. They may be summarized as follows: when the attention process moves smoothly, respiration and circulation progress with regularity. Strained attention is accompanied by more vigorous bodily reactions than low-level relaxed attention,—but both agree in relative regularity. Breaks and shocks are followed by relatively violent bodily changes. Emo-

[1] From the Psychological Laboratory of the University of Michigan.

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tions are states of instability; attention is spasmodic and interrupted. This instability is greater in disagreeable than in agreeable states. Solving a problem that requires merely relatively strained attention is regular attention. If one becomes confused or anxious, we get irregular attention.

No factor, vasomotor, rate or amplitude of pulse, position or emphasis of dicrotic, or rate or amplitude of breathing changes regularly in one way for agreeable and the opposite way for disagreeable conditions. Almost all emotional states, agreeable or disagreeable, produced constriction. Amplitude of pulse decreases in almost all emotional states. The rate of the heart is sometimes increased on an average, sometimes decreased, sometimes not changed at all. Increase of rate is most frequent, but the more significant fact is the irregular rate with emotions.

The results with sensory stimuli vary. The most pleasant experience (harmony) always caused constriction. Unpleasant odors caused dilation in a few instances. The rate of the heart with sensory stimuli increases about as often as it decreases.

Mental application gave a slight amount of vasomotor change, frequently so slight fluctuations as to be hardly noticeable. Respiratory rhythm disappears. Intellectual states are distinguished from the affective states by the greater regularity, and not by any uniformity in the direction of change. In about half of the mental application tests there are both vaso-dilation and vaso-constriction in a single test. When the change is in only one direction, it is an even chance that it be dilation or constriction.

Lehmann, in the first part of his work, "Körperliche Äusserungen psychischer Zustände" gives considerable space to a study of the normal condition. Perhaps the most surprising statement is that the long undulations of the volume curve are called forth by vague conscious conditions which are not able to catch the attention. He says that these waves do not appear in deep sleep, and the changes in heart-rate are very small in the gradual undulations. Such a conception of these waves is a source of error throughout the book.

A concentration of the attention, according to Lehmann, is immediately accompanied by a few quickened pulses, during which the volume has a tendency to rise; then follow four to eight slow pulses and the volume falls; finally the volume rises again with quickened pulse. Taking all these phases together, the length of pulse is always shortened. If the activity is more lasting, the volume remains nearly at the normal after the last rise, but with much shortened pulse.

With involuntary attraction of the attention by a sudden external stimulus, the arm volume usually rises slightly at

first, then sinks, and lastly rises to normal. While the first pulses after the stimulus are shortened, the condition as a whole is characterized by a lengthened pulse, which shows more in the sinking than in the rising volume.

During strain of expectation, the volume of the arm is lessened, the height of pulse is small, the length of pulse varies but little from the normal. The reactions to various stimuli are obscured. If the strain is strong, external stimuli call forth only changes in the frequency of the pulse; if less, they cause a rise of volume which is soon lost. If the strain ceases, the volume rises with higher pulse.

In an indifferent mood, the bodily expressions of weak stimuli are independent of the feeling tone; if the attention to them is purely involuntary without active strain, the only change is lengthening of the pulse. If the stimulus causes some active attention, the volume changes of these states come in, but with lengthening of the pulse unless the active attention is too prominent. During a state of strain each new direction of attention is expressed by a volume change which is to be considered as a resultant of the changes which the new activity would cause of itself, and the rise of volume which is a consequence of the lessening of the strain. It is difficult to accept the author's explanation that, with maximal strain, the two forces arise side by side so that the volume remains nearly unchanged, while with weaker strain, one gets a predominating rise of volume.

Disagreeable sensations cause a strong and persistent fall of volume with decrease in the height of the pulse as well as its length. If the volume rises again, the height of the pulse rises also. With weak disagreeableness, the pulse begins to lengthen as the volume rises; with strong disagreeableness it shortens still more during the first of the rise and at the original level of volume the pulse length is usually markedly less than the norm.

A depressed mood is distinguished by the marked undulations. Agreeably toned sensations and other pleasant conditions, not very complex, express themselves by increase in the height and lengthening of the pulse; while the volume usually only immediately at the beginning shows a slight fall and then quickly rises above the original level. But one generally does not find all these changes in the same curve.

An external stimulus must affect consciousness in order to cause organic reactions. To the degree to which another state distracts attention from it, so far its special bodily expressions vanish. An agreeably or disagreeably toned sensation suggested in a hypnotic state calls out the same bodily changes which accompany the sensation when caused by a stimulus

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under normal conditions, even though there may be acting a stimulus which of itself would cause different reactions if it came to consciousness.

In the second part of his book, Lehmann develops a theory of agreeableness-disagreeableness which he states briefly about as follows: when a psycho-physiological process demands no greater use of energy of a neuron than the assimilative changes are able to supply continuously, then the psychical effect will be an agreeable feeling while the physiological effect will be a stimulation of changes in other centres. The maximum of agreeableness is attained when the assimilative processes can just supply the demand. When these limits are exceeded, the agreeableness and the stimulation are both decreased; the demand in the active centres now causes an inflow of energy from the surrounding parts by which simultaneous processes in the latter are inhibited. We get then a neutral condition; and finally, if the need in the active neurons is so great that it cannot be supplied by the assimilation in connection with the intercellular stream of energy, the psychical effect will be a disagreeable feeling. An inhibition of other simultaneous processes will therefore accompany disagreeableness, except when this is of too short duration to allow an inflow to take place (as in fright).

Taking the curves published in Lehmann's atlas and the descriptions given by Lehmann of the conditions under which they were taken, Wundt attempts to show that in so far as the experience is exciting in character there is some increase in volume, increase in height of pulse, but no change in the pulse length; in so far as it is quieting, the reaction is the reverse. With agreeable states the volume is increased, the pulse heightened and lengthened; with disagreeable the reverse conditions hold. Strain gives a decreased volume, a weakened and lengthened pulse; relaxation the reverse. Wundt believes that in this way a better interpretation is obtained for Lehmann's results.

Brahn begins his article with a careful account of introspections in which he finds that Wundt's tridimensional division of feelings is justified. In his experimental work, he considers only the length and form of the pulse. He measures the single pulse beats, but very roughly, and uses only a few before and after the stimulus. He states that subliminal stimuli cause a slight lengthening of the pulse; that there are three pairs of changes in the pulse corresponding to three directions of feeling: agreeable states give longer and higher pulse, disagreeable shorter and lower; exciting higher and no change of length, depressing lower and of the same length; strain shorter and relaxation longer pulse. The changes in each case come in a

few pulses after the stimulus and last several beats. There is a periodic strengthening and weakening of the expression with strain corresponding to the variations of attention.

W. Gent finds with *Spannung*—a sort of indefinite expectation—if it is of short duration, a short fall of volume, more or less lessened height of pulse, and, most prominently, lengthening of the pulse; if of longer duration, the volume curve also remains low with very small waves.

With relaxation, the volume rises above the norm, generally with respiratory waves; the pulse is shortened. No feelings can be isolated except *Spannung* and *Lösung;* in all other places we have resultants.

Concentration of the attention as found in the solution of a problem or in counting marks gave a shallow and more regular breathing, a fall of volume and decreased height of pulse, with waves; there is no constant change of pulse length. From this he thinks the feeling is a mixture of "*Spannung*" and "*Erregung*." One must question, however, whether "*Spannung*," as he uses the term, is not the complex.

So far as a state was disagreeable it gave a fall of volume and height of pulse and shortened pulse length. These changes will be more or less complicated by the strain and exciting effects present, less so if the disagreeableness is strong. Agreeableness causes a rise of volume and height of pulse with greater respiratory waves; the pulse may be lengthened or shortened during the stimulus, but there is always a shortening after the stimulus.

Gent thought to get excitement by suggesting the arm as active or that its volume should rise; depression, by suggestion of the reverse. The reaction for excitement was the rise of volume, heightened and shortened pulse. The shortened pulse was obtained only by the method of suggestion. Depression gave the reverse reaction.

P. Zoneff and E. Meumann report quite fully the results of experiments in which they are mainly concerned with the accompaniments of mental processes in the heart rate and the breathing. They study not only the rate but also the depth of both chest and abdominal breathing. Working with attention to optical, auditory and tactual stimuli and to the solution of arithmetical problems, they find that, in general, a voluntary concentration of attention causes a slowing of the pulse and an inhibition of the breathing, greater in the chest than in the abdominal breathing. The breath is much more affected by the sensory than by the intellectual attention. The waves of the attention correspond to waves in the pulse and breathing changes; with weakening of the attention the pulse frequency and total amount of breathing increase.

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Turning to the agreeable and disagreeable feelings, the authors state that all agreeable processes cause a shallower and more rapid breathing, with slowing of the pulse, all disagreeable processes give deepening and slowing of breathing and a quickening of the pulse. The chest breathing is more affected than the abdominal. If we consider both the rate and depth of thoracic and abdominal to get the total amount of breathing, we see that agreeable states lessen the breathing activity, disagreeable increase it.

The effects of the feelings vanish with a distraction of the attention by another stimulus. The authors also study the results of concentration of the attention upon the stimulus and upon the feeling, and show that a mere direction of the attention to the feeling strengthens it, but it is weakened if made the object of a psychological analysis.

One of the most interesting of the articles that have recently appeared is that by M. Kelchner, on the relation of breathing and pulse changes to stimuli and feeling. After a thorough criticism of Lehmann's work, the writer passes to the experiments on agreeable and disagreeable states caused by taste, visual and auditory stimuli. Agreeable tastes give quickened pulse, agreeable tones and colors a slowed pulse. The quickening of the pulse with taste stimuli is less, the more agreeable the experience, so that longer pulse seems to be here the natural expression of agreeableness. The pulse increases in rate generally with disagreeable states. The breath changes, with both agreeable and disagreeable, show great individual differences. Pulse and breathing are to a certain extent independent variables, and there is a great difference in the significance of the two as expressions of the feelings. The individual differences are found in depth and rate changes as well as in the relative part of the chest and abdominal factors, so that it is always necessary to consider both breath curves.

Strain was studied mainly by announcing a reaction of some sort which should take place at a second signal. Quickening of the pulse was the result; the breathing showed great individual differences. Relaxation gave the reverse of the expression of strain, and this was true, even in the individual differences. If strain precedes and turns to relaxation at an agreeable or a disagreeable process, the relaxation simply displaces the other feeling reaction, and the result is indifferent to the nature or degree of the agreeableness or disagreeableness.

Cutaneous pain gave rather uneven results. There was a tendency to faster breathing. The pulse was quickened, except with one subject.

A faster pulse and an irregular, generally somewhat quickened breathing, accompanied fright. There was a slowing of

the pulse afterwards, which seems to correspond to the feeling of relaxation which may follow fear.

A most careful recent investigation is that of H. C. Stevens in his article on the plethysmographic study of attention. He determines the volume changes and measures the heart rate from the plethysmographic curve,—a practice which will generally do very well, except that the method of counting the number of pulse beats in ten seconds, almost invariably used, is all too rough and meaningless.

Visual, auditory, and tactual attention, and attention to multiplication were studied. For visual attention, the rate of respiration was much increased, the pulse rate did not change consistently. With auditory attention the pulse rate was decreased, the respiratory change uneven. Both pulse and respiration were slowed for tactual stimuli. The results with multiplication were like those with the visual group, and the work was probably thought of visually. The most marked result in all attention was inhibited breathing and decreased volume of the arm.

Such variations of the results with the sense organ concerned leads the writer to the conclusion that the changes in rate of pulse and respiration are due simply to the process of sensation, not to the attention at all. And to be connected with this is the statement that "every sensory stimulus tends to produce a fall in the volume of the arm."

R. Müller has published an article in which he criticises the use of the plethysmograph for psychological purposes. The paper is well worth reading; but I do not think it necessary to review it nor to offer any reply, as I have recognized in an even more thoroughgoing way the facts that he urges.

In a recent book, Elemente der Psychodynamik, Lehmann gives a further discussion of the problem, and reports some experimental researches. After summarizing previous results and criticising the tridimensional theory, he develops his theory of feeling in connection with Verworn's theory of Biotonus. If assimilation ÷ dissimilation = 1. the psychic state is agreeable, and the stronger; the greater both assimilation and dissimilation are. If assimilation ÷ dissimilation < 1. the state is disagreeable. The Biotonus of the neurons will vary with the kind as well as the strength of the stimuli, and the value of dissimilation, with which assimilation ÷ dissimilation becomes less than 1. will vary with different conditions of the organism. If assimilation ÷ dissimilation < 1., the effect will be to inhibit other processes, and so the vagus centre. This will give an increased heart rate, which will send more blood to the brain, and so increase the assimilation. When assimilation ÷ dissimilation = 1., the vagus centre will be stimulated and so the heart

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rate decreased, a result which is also teleological since the heart is relieved when great flow to the brain is not needed. "The feeling-tone is the psychical indicator of the Biotonus of the acting centre, whose bodily effects we find in the circulatory changes."

In the experimental work, Lehmann measures also the transmission time of the pulse waves, a method which is suggestive but which needs a more thorough treatment. He finds that no respiratory waves appear in the normal arm volume unless the breathing is very deep. They usually appear if the volume and height of pulse increase above normal; if they occur with quiet breathing and normal height of pulse, the subject is either sleepy or depressed. Of especial importance is the fact that he retracts his previous statement that the gradual undulations in the volume curve are due to vague conscious states. He now grants that there may be such waves without a correlate in consciousness, and which are, he thinks, due to a rhythm in the heart rate. He denies that these waves are effective in the time of transmission of the pulse wave, which means that they are compensated by vasomotor changes. But there are yet longer variations in the transmission time which are in the same direction in the carotid and radial arteries and in the opposite direction in the tibial, so that the two compensate each other and leave no trace in the volume. The results are to me, however, far from convincing.

"Every intense mental effort of considerable duration causes a greater frequency of the heart, expansion in the carotid, which probably continues after the work has ceased, and also constriction in the radial artery." This agrees with Berger's statement that concentration of the attention is connected with increased brain volume and height of pulse, which lasts until after the end of the work. Yet Lehmann finds that *Spannung* and expectation are expressed by decreased arm volume and small pulse which depend upon a constriction in the radial artery; and, in the carotid, no circulation changes can be indicated with certainty, which he connects with Berger's assertion that in *Spannung* there is no change in the brain curve, neither in volume nor height of pulse.

His results with sleep and related phenomena, seem to me very uncertain; I leave them for future consideration.

This writer finds that the characteristic of simple agreeable feelings is the expansion in the radial and the carotid; which agrees with Berger's result that agreeable processes go with a decrease in brain volume and increase in the height of the brain pulse.

To his former results with disagreeable states he adds that they are accompanied by a constriction in the brain. This he

infers from the decreased time of transmission of the pulse in the carotid, which continues after the heart becomes slower. Again he agrees with Berger's statement that "disagreeably toned sensations cause an increase in brain volume and decrease in height of pulsations in the brain." This contraction of brain vessels and decreased height of pulsations, it is explained, protects against a too rapid dissimilation.

The Peripheral Volume Changes.

The first experiments were designed to test the changes in peripheral volume and the depth of breathing. It was, at first, thought that the heart rate might be measured from the same curves, but this idea was soon abandoned for reasons to be discussed later. Three forms of the plethysmograph were used at one time or another during the experiments. We may consider them separately.

Zimmermann's modification of Lehmann's plethysmograph was used during the latter part of the first year's work. While this modification is probably inferior to Lehmann's original form, there are many objections to the use of either for this purpose. It is too much of a stimulus to the subject, involves too much preparation on his part and may easily become positively uncomfortable. It is little wonder that Lehmann obtained so many abnormal results, because the reactions were preceded by a state of *Spannung*. It is with great difficulty that movements are eliminated. Every swing of the arm in breathing, every jump, every contraction of the muscles of the arm is almost certain to be directly recorded in part at least. Again, it is too directly affected by the pulse in the large blood vessels, the outflow from the large veins, and, relatively, at least, cannot record delicately changes of volume so far as these are due to constriction or dilation of the small arteries. The results obtained by its use were not in conflict with those from the other instruments, but were not nearly so clear or certain. It was therefore abandoned in favor of the other forms.

It will be convenient here to notice a change made in recording the curve from Lehmann's plethysmograph. The Marey tambour is probably universally used for this purpose. But it is also very unsatisfactory. The unequal yielding of the rubber at the sides of the disk in response to the motion of the lever, the variable tension of the rubber at different heights of the curve tend inevitably to obscure the record. For this reason a piston recorder of large size with hard rubber plunger was made and used in place of the tambour. A much more delicate response, both as recording the long waves and any reaction to stimuli was obtained by this means.

The next plethysmograph to be considered is the Hallion-

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Comte, an air plethysmograph. Objection may be made to this instrument in that it does not include all of any part of the body, so that some of the record desired may be lost; and that, if it is used on the hand, the subject may involuntarily squeeze the bulb, particularly at the time of a shock, and thus obscure the result. These abrupt movements, however, may in general be easily distinguished from other changes. The apparatus is useful when the pulse in the finger alone is not sufficient to give a fairly large record, as is often the case with women, and was retained for this purpose. It was also used for the peripheral pulse later when the brain and hand (or foot) curves were taken side by side. For it is the most convenient form available in taking a long record, as was done particularly in work on sleep. It was always used with a moderate sized piston-recorder with plaster of Paris plunger. When so combined, it is the most delicate apparatus we know for studying the vasomotor waves.

We come lastly to the finger plethysmograph, described by Lombard and Pillsbury in the *American Journal of Physiology*, Vol. III. This is altogether the most satisfactory when it can be used. It is easily and comfortably operated. It reports changes which are probably as nearly vasomotor as one can obtain. Movement of the arm affects it comparatively little. It was always used with the most delicate piston recorders, indeed the tambour will write practically no tracing with it. When so adjusted, the apparatus requires more care from the operator, particularly in attending to the recorder, but requires less from the subject, and is excellently adapted to the task in hand. Instead of warm water in the outer cylinder, a towel was generally spread over hand and plethysmograph if necessary. As a result, the air in the inner cylinder was sometimes growing slightly warmer during the first tests and causing a slow rise of the needle. But in almost no case was this large enough to interfere with an accurate reading of the result if a reasonably long curve was taken.

It must be confessed that there is one objection to this arrangement: the tracing is often very faint. The pressure of the needle of the recorder upon the drum must be so light that the mark is often not heavy enough. It can be seen easily if the records themselves are studied, but cannot be published except at considerable expense. For this reason, I shall select comparatively few curves for reproduction, and in fact mainly those illustrating agreeable and exciting conditions, the most disputed reactions. This, however, can be no great deficiency, since the whole story is practically told by these few, and since I have studied with special care any curves that might possibly be interpreted as the reverse of the correlation found.

Of the breathing record there is little to be said. A Sumner pneumograph was used on the chest and connected to a Marey tambour by rubber tubing. The intention was to show the changes in amplitude of chest breathing alone. This is, to be sure, inadequate to test a possible finer correlation between breath changes and mental process, since we should, for this purpose, know the total amount of breathing in both chest and abdomen; but it is sufficient to detect any changes that might materially influence the circulation. The variations in rate, like those of heart rate, were measured by more accurate methods in later experiments.

The kymograph used in the earlier experiments was one made by the Chicago Laboratory and Supply Co. That used mostly after the first six months was the Zimmermann pattern with Hering's slide. Along with the piston recorder writing the pulse and the Marey tambour tracing the breathing wave, and just above the latter, a magnetic indicator was used to mark the time at which stimuli were given. Above this was a time marker recording seconds in the first experiments, but this was of no importance after it was decided that the heart and breath rate must be studied in another way.

Among the stimuli used at one time or another during the experiments were agreeable and disagreeable smells, agreeable and disagreeable tastes, colored lights, deep and shrill whistles, chords or discords on tuning forks, music on stringed instruments (the violin and the zither), noises, attention to counting marks or a minimal sound, to a touch or to a multiplication, recalling of emotional experiences, listening to amusing reading, etc.

The arrangement in the first experiments was as follows: The finger plethysmograph was suspended at a convenient height from the floor by the side of a table. On this table were the kymograph, the rotating standard holding the recording apparatus, the syringe and its attachments used to adjust the level of the recorder needle, the electric key connected with the indicator, and part of the phials containing smell stimuli. On a stand near the operator, as he stood facing the kymograph, were the tuning forks and other objects needed to give the stimuli. The subject sat in a comfortable position next the plethysmograph; his arm rested in the swing and his eyes were closed except when he was told to open them to count marks, etc. The second finger was generally used in the plethysmograph. The room was quiet.

After the apparatus was adjusted so that all parts were working satisfactorily, a normal record was run for some time, a stimulus was then given, after which time was allowed for recovery, the kymograph was stopped, the stopcock turned and

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the subject asked to give his introspection. This was written down and numbered to correspond with a number on the record. The indicator circuit was closed at approximately the time at which the stimulus was applied, although it was sometimes impossible for the operator to do this exactly.

In the later experiments the subject and operator were in different rooms. Both were dark rooms, that in which the subject sat was closed securely so that no light was visible except when an electric lamp was burning. The subject could hear practically nothing of the movements of the operator. The plethysmograph was suspended near the wall and beside a table. There was a hole leading through the wall to the other room. Through this hole passed the tubes from the plethysmograph and pneumograph to the recording apparatus which stood on a table next the wall. Through this also passed electric wires for signal keys, tubes attached to the whistles so that the operator could blow them at any time, and wires for two electric lights. What space was left through the hole was lightly packed with cloth. The electric lights were turned on or off from the operator's room. They were hung near the wall in front of the subject. Colored bulbs were made and used in them. The colors were red, yellow, green, blue, and violet, as well as the usual white. So the subject could be exposed to any of these lights or left in total darkness. A signal could also be easily given for any kind of mental work. The taking of the record and the introspections were analogous to the procedure in the first experiments.

The subjects for these experiments were Professor Pillsbury, Mr. Wright, a graduate student; Mr. Bayley, Miss Udell, and Miss Killen—senior students; and the writer. Professor Pillsbury, Mr. Wright, and Mr. Bayley served for most of the work. In about two hundred of the earliest experiments made, the introspections are insufficient to classify the experience accurately in the three directions of feeling. It was more or less a training period. The results obtained may be reviewed very briefly. And, in the first place, it may be noted that here, as in the later experiments, many tests gave no determinable result. Nor is this due to any fault of the apparatus, for undulations, and other changes when they occurred, were recorded more delicately than is usually the case. There was almost always some undulation, and the reaction was simply too weak to be distinguished from it. In truth this same fact was found with the Lehmann plethysmograph. Nor were the subjects in a state of strain; the pulse was normal, showing nothing of the constricted character it does during strain. And it might be an agreeable or a disagreeable experience which gave no response. A stimulus does not necessarily give

a definite reaction. All tests that could reasonably be interpreted as giving either rise or fall of volume were selected, the others neglected as determining nothing. Those also were omitted which were introspectively unsuccessful or meaningless; and of these there was a considerable number when the more accurate introspections were required.

As illustration of a test which gives no definite rise or fall of volume, we may give Chart W 31. (Pl. 1.) The stimulus was a chord, discord, and chord in succession. There was a marked change in the breath; the whole pulse curve is slowly rising with the warming of the air in the tubes, but shows no determinable reaction to the stimuli. The vasomotor wave here is not so large as is often found. Like phenomena may be obtained with simple or complex stimuli.

Summarizing roughly the results of these preliminary experiments, we find that nineteen agreeable stimuli gave a fall of volume distinctly, while four gave a possible rise. Fifteen disagreeable stimuli gave a distinct fall, and two a possible rise. Four shocks and five attentions to a touch sensation were accompanied by a fall. There was a fall with several cases of strain of expectation. One agreeable smell falls apparently upon a Traube-Hering wave, and in the same record is a disagreeable smell accompanying at least as prominent a wave. The same is true of two chords and a discord. Only one rise seems to be due to the stimulus, and this is with an agreeable smell which has led to deep breathing, the rise is apparently only a short effect of the breathing, and is followed by a fall.

Turning now to the records with which more careful introspections were taken, I shall describe a few typical cases.

W 166. Multiplying. The work was done easily, with some effort, but no confusion. Subject pictured the number and the result. He discovered a little mistake just at the end and that caused a momentary unpleasantness, but only a little and this near the end. Strain was practically the only feeling present. The volume curve as a whole was slowly rising, the effect of the stimulus was a fall with smaller pulse. Due to the displacement of the recorder needle in its arc, the whole pulse curve should be moved back somewhat; measurement shows the fall began about two pulse beats after the stimulus was given. The breathing was slightly deepened. The subject raised his finger a little to indicate where the work was done. (Pl. 1.)

W 167. The stimulus was again multiplying, and the conditions practically the same as in W 166, except that the work required a little more effort. The breath was not much changed, somewhat shallower. The volume decreased. (Pl. 1.)

B 20. The subject was asked to attend to a faint watch tick, to get, if possible, the attention wave. The condition was one of strain only. The pulse had just about recovered from a previous fall, the result of the work was fall of volume with lower pulse. Undulations were present in the pulse during the stimulus period, breath waves before the stimulus and in the latter part of it. The volume rose with the feeling of relaxation afterwards. The breathing was distinctly shallower during the stimulus. (Pl. 1.)

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W 104. The stimulus was carbon-di-sulphide. Disagreeable, no particular strain of attention, nor excitement, nor depression. The result was a fall of volume, smaller pulse, and inhibited breathing. (Pl. 1.)

S 83. Oil of violet. An agreeable sensation with no particular strain of attention and no excitement. Subject in perhaps a little strain before. The mark was pressed a little early. The result is a fall of volume with smaller pulse. (Pl. 2.)

W 89. Camphor followed by cinnamon. Both agreeable, perhaps a little excitement, did not want either to cease. Again the result is a fall of volume. The breathing was a little deeper at first. (Pl. 2.)

B 9. (The curve is not reproduced.) Cinnamon. It was announced to the subject at (a) that cinnamon would be given. The smell was given at (b). The breathing was somewhat deeper after the announcement until the smell was removed. The pulse curve was slowly rising on account of the increasing temperature in the tubes. The stimulus caused a fall of volume and somewhat smaller pulse.

P 129. The stimulus was a violet light. It was agreeable and a sort of weird, little exciting light. There was marked depression when it was turned off. So the succession was an agreeable excitement, followed by a depression, the latter perhaps slightly disagreeable. The marker current was broken a little too quickly as the operator had to move a little to turn off the light after breaking the indicator circuit. There was a fall with smaller pulse beat both at the appearance and disappearance of the light. The breathing was scarcely changed. (Pl. 4.)

P 145. This record was taken with the Hallion-Comte plethysmograph. The stimulus was a violet light. It was agreeable and arousing, although the arousing effect was not so great as with the white light. The breathing was a little deepened. There was a preliminary rise followed by a fall. This was one of the very few rises obtained. And it may well be only a somewhat larger Traube-Hering wave, a kind of appearance which quite often occurs in an indifferent condidition *as well as in deep sleep*. (Pl. 2.)

B 27. The stimulus was the major triad C, E, G. There was no surprise, the stimulus having been announced just before. It was distinctly pleasant, possibly a little arousing. No especial strain of attention. The breathing was not changed uniformly. The volume curve had been artificially dropped a little before the stimulus, to bring the needle more nearly to a level position. The stimulus caused fall of volume with lower pulse. There was some breathing and Traube-Hering wave all through. (Pl. 3.)

W 87. (The record is not reproduced.) The stimulus was again the major triad, turned to a discord in the middle, then major triad again at the last. The discord was practically indifferent, the triad agreeable. Little surprise. The volume fell during the first sounding of the triad, while the feeling was little more than agreeable.

B 6 S. This is a curve taken while the subject was listening to music by Sousa's band. The feeling was agreeable and stimulating. This gives a decided fall in the volume, with smaller pulse. The Traube-Hering wave shows all through. (Pl. 3.)

W 76. The stimulus was the major triad. It gave a decided start, the tones were pleasant. With the tendency of the tones to be felt as pleasant and of the surprise to make the whole unpleasant, it is impossible to say that this was more than a state of excitement. Indeed this seems to be about the only way to get excitement unmarked by a particular agreeable or disagreeable tone,—to have both agreeableness and disagreeableness so suggested that one cannot say the feeling is to be called either. The result was a fall of volume with lower pulse. There was, of course, some attention, but no marked strain. (Pl. 2.)

W 96. Again C, E, G is the stimulus. A surprise, and not especially agreeable. Probably little more present than some excitement. The volume falls with smaller pulse. (Pl. 2.)

B 58. The violet light was on from the start and was turned off at the mark. This gave rise to a depressing, "closing in" feeling,—a somewhat disagreeable depression. The volume fell for a short time. The breath wave in the volume shows throughout. The subject was merely resting before. (Pl. 3.)

P 111. The stimulus was an unexpected noise. The subject was startled. The experience was disagreeable and exciting, perhaps some strain later. The fall of volume was marked. (Pl. 3.)

B 28. Noise. Shock which lasted almost all through, a sense of disagreeable excitement and strain resulting. There is a temporary check in the breathing; a suggestion of rise in the volume curve just preceding the marked fall. In this case the rise may be no more than a broken breath wave, but we shall see later a meaning which such a rise might have. It is worth noting here, however, that there is often no suggestion of it in the shock tracings from the finger plethysmograph. The breath wave in the normal pulse is crushed out in the reaction. It should be stated that this subject almost always shows more or less breath wave in the pulse, although under no strain or abnormal mood. Different persons show great variations in this respect. (Pl. 4.)

It is useless to reproduce more of the results here, especially as almost every condition will be illustrated later in studying the changes in peripheral and cerebral circulation. I shall pass now to a treatment in tabular form.

Those cases were omitted which showed no determinable reaction, as well as those which could not, on the basis of the introspections, be classified. About one hundred and fifty were thus retained out of four hundred and fifty experiments made. To tabulate the results, columns were ruled upon blank paper for the following headings and in the order given: Number of the Experiment, Stimulus, Introspection of Conscious Condition, Volume Change, Wave in Volume, Height of Pulse, Depth of Breathing, Remarks. Each of the usable results was then carefully studied and recorded under each heading. The introspection was analyzed and stated in terms of agreeableness-disagreeableness, strain-relaxation, excitement-depression. In the volume column, C is used for fall, R for rise and Sr a secondary rise which quickly changes to a fall of volume. Under the heading "Wave in Volume," B is used for breath wave and T. H. for the Traube-Hering wave, or perhaps better called Mayer wave. + is "present" and "—" absent in the succession normal, reaction, recovery. When either period is not long enough to determine the character of the wave a "o" is entered in its position. ± signifies a stronger wave and ‡ a much stronger wave than is found in another period marked by a +. A —— in the wave column means that there is no wave that can be followed. In another column it signifies "no change." These abbreviations will also be used to tabulate the heart and breathing rate changes later.

TABLE I.

No. of Exp.	Stimulus.	Introspec-	Volume	Wave in	Height of	Depth of

I shall now give a few of the detailed analyses in the following table (Table I).

TABLE I.

No. of Exp.	Stimulus.	Introspection.	Volume Change.	Wave in Volume.	Height of Pulse.	Depth of Breathing.	Remarks.
U 40	Violet.	Agreeable.	C.	T. H. + + +	Sl. decrease.	Increase.	
W 109	Cinnamon.	Agreeable.	Sr. then C.	T. H. + + +	Decrease.	Inc. marked.	
W 112	C. E. G.	Agreeable.	C.	T. H. + — —	Decrease.	Decrease.	Little fall from the suspense at sudden stopping.
B 80	Discord (announced before).	Some surprise at announcement. Disagreeable.	C. at ann'ncement and at discord.	B. + — +	Decrease.	————	
B 10	Caproic acid (announced before).	Disagreeable.	C.	B. + — —	Decrease.	————	
W 128	Multiplying.	Strain.	C.	————	Decrease.	Irregular.	
B 22	Drawing on face (ann'ced before).	Strain.	C.	B. + — —	Decrease.	Decrease.	
S 107	Violet light.	Excitement. Agreeable.	C.	————	Decrease.	Increase.	
P 150	Blue light.	Agreeable. Exciting.	C.	————	Decrease.	Slight decrease.	
P 141	High whistle.	Excitement. Disagreeable.	C.	T. H. + — —	————	————	
W 79	Noise.	Disagreeable. Exciting. Strain?	C.	————	Decrease.	Increase.	Catch in breathing.
K 8	Drawing on face (ann'ced before).	Announcem'nt caused *Shrinking*. Strain at drawing.	C. in each case.	T. H. + + —	Decrease in each case.	Decrease.	
P 128	Yellow light.	Pleasant. Depress'ng and disagreeable when turned off.	C. with light and also when turned off.	————	Decrease when turned on and when turned off.	Slight decrease.	
B 79	Sorrow by suggestion.	Disagreeable and depressing.	C. marked and quite irregular.	B. — + —	Decrease.	Increase.	Breathing slowed.

The expression "Drawing on face" means that a figure was drawn which the subject should try to recognize. The stimulus in B 79 was by suggesting a very sorrowful event in the sub-

ject's experience. It will be noticed that P found a blue light more exciting than depressing.

We may now summarize the volume changes as follows, having regard to all the results retained as of value. Twenty-two cases of strain gave a fall of volume. Relaxation gave a rise. There may be a temporary fall at the first moment of relaxation. Eleven cases pronounced distinctly agreeable with no other feeling to be noted gave fall of volume, generally quite marked. Five agreeable gave a preliminary rise followed by a fall, in three of which the fall was much more marked than the rise. There was a rise with two others. Eighteen agreeably exciting caused a fall, and one a preliminary rise followed by a fall. (P 145.) Eight merely disagreeable gave a fall and one a rise. Five cases of excitement were accompanied by constriction. There was a fall with two depressing and four rather disagreeably depressing. Over fifty curves, mixtures of disagreeableness, excitement, and strain in nearly all proportions,—all gave a fall of volume, generally very large. Two indifferent stimuli caused a rise by comparative relaxation from a preceding strain.

It will be seen that the reaction is almost universally a decrease of the volume. It is probable that none of the rises were due directly to the stimulus. Six of those with agreeable conditions were with smells in which the amplitude of breathing is always more or less, generally greatly, increased. The first effect of deeper breathing is always a temporary rise. The other rise with agreeableness comes when the subject had been thinking intently upon another problem just before, and the stimulus, a chord, comes as a comparative relaxation. The rise with agreable excitement we have already seen is probably a Traube-Hering wave, and that with disagreeableness is about like it.

The importance of the Traube-Hering wave in confusing results is not generally appreciated. It is present in the charts published in the literature more than is usually recognized. There is probably no time when some considerable trace of it may not be obtained with fairly delicate apparatus. Far from being absent in deep sleep, it is more important then than in an indifferent waking state. It is often very prominent in sleep when the subject can remember of no dream even if waked immediately. I have easily traced it through several hours of deep sleep with practically continuous records, in fact through the whole night's rest. To be sure, it is often more prominent in the volume in a condition of drowsiness, particularly just before sleep, but not so marked after a long sleep. Even then it may not be so prominent in the other functions and sometimes the largest waves are found in sleep. It is

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not due to vague conscious states, but is a physiological rhythm probably of the vasomotor centres and secondarily modified by a rhythm in the heart rate.

The size of the pulse in these curves always decreases with fall of volume and increases with rise of volume. This, of course, makes no test of the changes in the heart beat directly, —the vasomotor changes tend to obscure any variations in the force of the heart action itself.

On many of the records, the waves in the volume were not marked enough to determine their changes. The only correlations that could be worked out are as follows: With strain (close attention) there is a tendency to crush out the breath wave, and perhaps also to some extent with disagreeable smells. The Traube-Hering waves tend to become somewhat less with disagreeably exciting (five decreased, to twelve unchanged) and with agreeable and agreeably exciting stimuli.

A study of the results under the heading "Depth of breathing" showed some points of importance, all of them, however, more or less commonplace. Agreeable smells deepen the breathing and disagreeable and disagreeably exciting make it shallow. A disagreeably exciting sound or a noise tends to deepen breathing and often makes it irregular also. Agreeably exciting stimuli at least as often increase as decrease the depth. Attention to multiplying or similar work gives a decrease more often than an increase, but the decrease is comparatively small. By all means the most marked lessening is with attention to sensory stimuli, as in counting marks or listening to a liminal sound.

A phenomenon of some importance for a theory of agreeableness-disagreeableness is the effect of an abrupt stop. Subjects often stated that the sudden muffling of the tuning forks left them "in the air," lost for a moment. This is much more marked if an agreeable chord is stopped suddenly than if we are dealing with a disagreeable discord, although there is no thought in either case of "wanting to stop it." A sudden interruption of a simple agreeable experience seems to be more felt as a change, a shock, than a like interruption of a disagreeable, and in two or three cases a noticeable fall of volume accompanied this shock with the interrupted chord.

The only instances which gave a rise of volume that seemed to be due directly to the stimulus conditions were with attention to the member in the plethysmograph, the finger, to count the pulse and note any other sensations that may come from it. The condition is one of strain only. There is here, too, a tendency to constriction, but also apparently a tendency which may cause the volume with or without a temporary fall to rise with increased height of pulse considerably above the normal and remain there until attention changes. The breathing and

probably heart rate changes are the same as with tactual attention generally. The following instance may be given.

B 65. Attention to finger. No particular surprise, a little when asked to cease attending. Some difficulty was experienced to put attention on the finger. There is a preliminary fall followed by a more marked rise, with a return to normal afterward. The depth of breathing is somewhat decreased. (Pl. 4.) Four cases gave a rise without previous constriction.

The Volume of the Brain and of the Periphery.

The subject for these experiments was a young man, Carl Jahnke, a laborer of fully average intelligence. About two and one-half years before this work was begun he met with an accident which necessitated removal of a piece of the skull, roughly eight by six cms. in area on the right side of the head near the Rolandic region. Motor control in the left forearm was injured for a time. The wound had healed well and the patient had worked in Ann Arbor over two years without inconvenience. The hair is rather thinner on the scalp covering the opening, and there is a considerable dip or hollow at that place. The scalp forming the floor of this dip can be felt to pulsate.

The peripheral volume was taken from the hand in all the experiments on waking reactions to stimuli. A Hallion-Comte plethysmograph was used and connected to a piston recorder. The breath was recorded with pneumograph and Marey tambour as before. To get the change in volume of the brain, the capsule of a tambour was taken and the top covered with thin rubber. A piece of cork cut to fit the dip over the trephine was fastened to this rubber by means of beeswax. A strong cloth bandage was then tied firmly around the head, covering the forehead and the occipital protuberance. From this another broad bandage was passed over the trephine to the opposite side. The hair was parted away from the dip (shaving the head was entirely unnecessary), the capsule inverted and the rounded cork placed in the cavity. This done, the broad top bandage was pulled firmly but not too forcefully down upon the instrument and tied. The capsule was then connected by a flexible rubber tube to a delicate piston recorder. The kymograph employed in most of the work was the Zimmermann model mentioned above, and in a large part a long extension paper was used.

The subject was always in one dark room and the recording apparatus in the other as before. In the experiments here reported he was comfortably seated at a table next the wall. The stimuli given were like those used in studying the volume changes described above, and, in addition, a secondary current

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was, in several tests, passed through the free hand of the subject. An exposed wire was, in these cases, employed for one electrode. This caused strong cutaneous pain with very little, generally no, contraction of the muscles of the hand and arm. Another person usually assisted me in giving many of the stimuli.

The introspections were taken as before. The subject was asked to describe his experience as fully as possible. He, of course, knew nothing of the tridimensional theory of feeling, but a little judicious questioning in addition to his description would bring out with practical certainty the character of the mental process. Naturally he was, at first, rather nervous, in a state of strain and uncertainty, and the results so far obscured. But it was not long until he became acquainted with the apparatus and methods so that the work became a matter of course. Hundreds of records have been taken from him during the past year almost as a part of his regular routine.

It may be noted here that the circulation in the scalp is negligible so far as its influence on the brain record is concerned. A chart will be given with a plethysmographic curve from the scalp and this will perhaps be sufficient to show the point. Movement also plays no important part in the tracings expressing the waking reactions to sensory stimuli. This is indicated by a consideration of the same curve. It was practically impossible to move the scalp in a way that would affect the trephine without interfering almost as markedly with the region of the bandages which always moved with the scalp. And any change in the bandages must have shown itself by raising or lowering the pressure in the tambour transmitting the pulse from the scalp at least as much as in the other tambour, since this one was over bone. And indeed it did in other experiments. But no such changes were noted in the curves showing the scalp pulse, although types of the only reactions in which movement could be suspected were obtained there. Furthermore, when movement is present its results are easily recognized. Several tests were made in which the scalp was moved in known ways by another person as also voluntarily (so far as he could) by the subject himself; and the effects are readily distinguished by their abrupt character and the kind of break they make in the pulse beats with which they start.

I pass now to a description of a few of the individual results. The chest breathing tracing is just below the indicator line; next is the plethysmographic curve from the hand; and below that the brain record.

No. 39. The subject was asked to attend to a faint watch tick. In a normal condition before. Considerable effort was required. Relaxed afterward. The volume of the hand fell with decreased and

rounded pulse. There was a secondary fall at the first period of relaxation after which the curve returned to the normal. The brain volume rose gradually with higher pulse, then returned regularly to normal; the dicrotic was relatively more elevated in its position on the pulse beat, and a little sharper. The breathing was rather shallower. (Pl. 5.)

No. 42. Assistant drew a figure on the hand of the subject, who, with eyes closed, was to attend to and determine the figure if possible. No surprise. Could not tell what figure was drawn. The condition was primarily strain of attention. The amplitude of breathing was somewhat decreased. The volume of the hand fell with more rounded pulse. The brain changed about as in No. 39. (Pl. 6.)

In this and all other charts the mark "art" signifies that the change was made artificially by means of the piston used to regulate the height of the needle of the piston recorder.

No. 40. (The curve is not reproduced.) A series of figures to be added, divided, etc., was read to the subject, who was asked to perform the task suggested. He, with closed eyes, followed the problem without confusion, except a little at the last. The amplitude of breathing is increased. The volume of the hand was decreased as usual. The brain volume rose a little quickly, then fell back and increased gradually to its greatest volume near the end. It then began its return to normal. The dicrotic in the brain pulse was higher in its position on the beat.

No. 88. Only the end of this experiment is given. The subject had been attending to a faint sound for some time, and ceased attending at the upward movement of the marker. There was no surprise when the signal to stop was given, but there was a marked feeling of relief. During the first period of relaxation there was a fall of the hand and rise of the brain volume, after which each returned to normal. There was but little change in the breathing. (Pl. 7.)

Such alterations in the brain volume are often as great, sometimes greater than in this curve.

No. 69. At a signal from the operator, the subject took chocolate into the mouth. The signal had been prearranged, so that there was some expectation of its coming, still there was a little surprise. The taste was agreeable. In the movement of opening the mouth, etc., the bandages were apparently disturbed somewhat, giving a rise in the brain curve which seems to be at first a combination of movement and vasomotor change. The volume and size of the pulse of the brain were increased with more marked undulations then gradually decreased. The volume of the hand fell. The breath was little disturbed except by taking the chocolate and occasional movements of swallowing. (Pl. 8.)

No. 144. Chocolate was again the stimulus. The subject was normal before and took the chocolate with less movement of the mouth. The taste was very agreeable. The volume of the brain increased with greater pulse and the dicrotic a little nearer the apex. The hand decreased with smaller pulse. The breathing was little changed except by swallowing at times. (Pl. 9.)

No. 73. The stimulus was quinine. The subject expected the signal, and there was but little movement in taking the substance into the mouth. The taste was very disagreeable. The volume of the hand fell markedly with low pulse; that of the brain rose with higher pulse and gradually returned to normal. The dicrotic in the brain became higher in position and less prominent. The breathing was a little uneven. (Pl. 10.)

No. 61. The stimulus was violet light. It was markedly pleasant

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and stimulating. The volume of brain and hand, were nearly, although perhaps not quite, recovered from the effects of the preceding test; that of the hand fell with the light, that of the brain rose, and both then gradually returned to normal. The dicrotic in the brain was sharp throughout. The breathing curve was interfered with by the fact that the needle of the tambour was striking against the electric marker at the top. The breathing was somewhat deepened at first by the light. (Pl. 11.)

No. 55. The stimulus was a chord. It suggested some church music to the subject. It was agreeable and somewhat arousing. The volume of the hand fell with decreased pulse, that of the brain rose with increased pulse as usual. The amplitude of breathing was decreased at first. (Pl. 12.)

No. 60. The white light was turned out at the marks. This caused the subject to feel depressed for a time. Again there was fall in volume of the hand and slight rise in that of the brain. (Pl. 11.)

No. 78. The stimulus in this experiment was an unexpected deep whistle which greatly frightened the subject. There was a temporary rise in the volume of the hand, but with decreased pulse. This was followed by a marked fall. The brain volume rose greatly with increased pulse, then fell nearly to the normal temporarily, finally rose again and gradually returned toward the normal later. The dicrotic was less prominent but no higher in position. This behavior is quite characteristic of all intense stimuli; and it may be noted that there is often some trace of it in part of the curves given above. (Pl. 13.)

No. 92. A chair loaded with weights was tipped over behind the subject seated in the dark room. Subject reported that he was "scared to death." Could not make out what was the trouble. It was a considerable time before he could collect himself again. The breathing was checked at first, shallowed and showed a tendency to inspiration, after which it became deeper. The volume of the hand rose a little with decreased pulse, then quickly fell so markedly that the needle had to be raised artificially several times. The brain volume rose with increased amplitude of pulse beat, then fell with an undulation to normal. It will be noted that the pulse beat at the time of this fall was smaller and more rounded. With the later fall in this same record it is the nearest approach to a tricuspid pulse that I have found in the brain, except in one curve to be given later. The slightly greater pressure of the needle upon the drum may be responsible for this, but it certainly suggests a hampered pulse. After this temporary fall, the brain volume rose so greatly that the needle of the piston recorder stuck at its base and could rise no higher, so that the full form of the pulse is not shown. The amplitude of the beat was enormous. Finally there was a quick fall with somewhat rounded pulse, and the needle had to be raised artificially. (Pl. 14.)

It is to be regretted that the record was somewhat marred in removing the long paper. There was apparently a slight leak in some of the tubes connected with the brain recorder.

No. 143. A whistle was blown loudly near the subject in the dark room. It caused a marked shock and jump, fright, which persisted for a considerable time. There was irregularity due to movement in the breathing curve, with a decided tendency to deeper inspiration, and fall of its level. The hand volume was so obscured at first by the movement that one cannot determine with certainty the changes which took place, but there was probably a preliminary rise with small pulse followed by a marked fall. The brain increased in volume greatly with high pulse, then fell with lower and somewhat restricted pulse, and, after a smaller undulation, rose again with enormous pulse, and finally returned gradually towards normal, with dicrotic nearer the apex than in the normal. (Pl. 15.)

No. 98. The stimulus was a secondary circuit through the free hand of the subject; an exposed wire was used as one electrode. It did not pain much at first, but became very strong later. It was then very disagreeable, but did not cause contraction of the muscles of the hand and arm. The breathing became irregular, with no distinct check in it, the level of its curve fell. The hand volume increased at first with smaller pulse, then decreased markedly. The brain showed a temporary rise of volume corresponding to the rise in the hand, followed by a fall, after which the second rise appeared. The hand then constricted again more markedly, probably as the current became stronger. The brain increased greatly, decreased and increased again just after the stimulus ceased. The subject expected another shock afterward. The volume gradually returned to normal. (Pl. 16.)

No. 141. The stimulus was again an electric current. It was strong and painful throughout, although not without some variations in the intensity. It did not cause contraction of the muscles. The breathing was deeper. The volume of the hand fell from the start with restricted pulse, and was raised several times artificially. The volume of the brain rose with two waves, a further short rise occurred near the end of the stimulus, after which it slowly returned to normal. The dicrotic moved nearer the top of the brain pulse wave during the stimulus. (Pl. 17.)

A check in the revolution of the drum caused a deformed curve a short distance before the end of the stimulus.

No. 157. Several experiments were made to test the part which the circulation in the scalp might play, as well as to determine further the effects of any possible movement, and this record has been selected to represent the reactions. A second pneumograph was used upon the abdomen. This recorded by means of a Marey tambour the curve above the electric marker line. The plethysmographic curve from the scalp was recorded in place of the volume of the hand. A second instrument, like that used over the trephine to transmit the changes of the brain to the recorder except that the cork used was flatter, was placed in an analogous position under the same bandage on the other side of the head. It was connected to the piston recorder before employed to write the hand changes. The circulatory variations in an area of scalp similar to that affecting the brain curve were thus recorded. Any movement of the bandage, which practically moved with the scalp, must affect this second instrument even more than that over the trephine, since the bone under the scalp would cause every change of position to be fully transmitted to the recorder.

The stimulus for this record was a low, grating noise made at the door of the dark room in which the subject was seated (the mark is a little late). It caused marked fright which did not entirely cease until the drum stopped. There was very little check in either the abdominal or the chest breathing. The volume of both brain and scalp increased with higher pulse, then decreased with smaller pulse, and lastly repeated this process a second time. The changes in the two curves go together. The pulse was almost anacrotic throughout. (Pl. 18.)

About one hundred and fifty curves showed clear results. In general, all agreeable or disagreeable stimuli, all sensory attention or attention to arithmetical problems, all agreeably exciting light or music gave a fall of volume of the hand with smaller pulse and more rounded dicrotic, and rise of volume of the brain with larger pulse, often a dicrotic raised in position and made sharper. A sorrowful condition as well as the de-

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pression from sudden darkness produced the same result. The strain of expectation when a neutrally toned stimulus was announced before it was given acted like any other attention—it increased the volume of the brain and size of the brain pulse, and decreased the hand volume and size of pulse. With relaxation there was quite often a fall of the hand volume and rise of that of the brain during the first period, a testimony to the importance of the adjustment period generally; after that a gradual increase of the hand and decrease of the brain to normal.

The first point to be noticed in studying these volume changes is the double character of the reaction, particularly with strong stimuli, fear, etc. The volume of the hand increases first with smaller pulse and then falls quickly to a much lower level with rounded pulse; that of the brain increases with large pulse at first, then decreases nearer or quite to normal and sometimes shows almost an anacrotic pulse, then finally rises markedly with high pulse and gradually returns to normal. There may be even further secondary undulations.

If you ask as to the cause of these changes, several possible reasons suggest themselves. In the first place, it may be thought that the sudden contraction of the muscles of the abdomen, as when one braces one's self for an effort, would force the blood from the visceral organs into the brain and peripheral parts, and that with the release of this tension one gets the secondary fall of the brain. But a voluntary attempt to expire, when the nose was held closed, gave no such quick, large rise as we find here. Again the breathing change is not nearly long enough to account for the rise which may cover several breaths; and in addition the main tendency is to inspiration modified by the irregularities of movement. This type of reaction also occurs in greater or less degree when there is no appreciable check in the breathing, as in some cases of fright and almost always with the painful electric shock. And in the latter case there was also no considerable contraction of muscles which might influence the reaction by compressing the veins.

The only other probable explanation of the preliminary rise is to ascribe it to a sudden violent contraction of the splanchnic vessels. For the change occurs in the brain, hand and scalp at the same time. The smaller size of the pulse in the hand may be due to the marked tendency of the arteries there to constrict also. Even then there are at least two possible explanations of the secondary fall in the brain. It is quite probable that the spastic constriction of the splanchnic is followed by as sudden dilation, or there may be more than one such wave. The sec-

ond more lasting rise of brain volume follows from the general constriction and consequent rise of pressure. This explanation is indicated by the fact that the later as well as the earlier changes of the brain and scalp occur together. It is possible, too, that there is a local contraction of the brain vessels themselves which is afterward overpowered by the rise with the general reaction. Such a possibility is suggested by the more nearly tricuspid form of pulse often occurring during this period and later. It may very well be that such local vasomotor control is active, although it is to be expected that it would not be sufficient alone to account for the decrease of volume. To decide the question, if possible, I expect to test other aspects of this reaction soon, especially as it appears in blood pressure measurements and in the rate of transmission of the pulse wave.

Another factor that may play some part in these volume changes is the variation of heart rate with strong stimuli which we shall study later. The waves in the rate, however, are of shorter duration and relatively little marked. Even the secondary decrease in rate below normal cannot explain the fall to normal or lower in brain volume, if we suppose it is working against a constriction of the arteries. For it does not occur in a majority of cases, and is generally small when it does appear, while there is practically always a decided volume reaction of this character.

A careful examination of almost any one of the curves will show that the Traube-Hering wave in the volume is quite parallel in brain and hand. A crest in the one corresponds to a crest in the other. The question at once arises whether this wave is here an active phenomenon so far as the brain and periphery are concerned, or whether the changes in each follow passively from the reverse changes in the splanchnic, as was found by Roy and Sherrington to be the case with asphyxiated animals. Here again an attempt will be made to measure the blood pressure changes; the variations in pulse form are doubtful. But I cannot discuss the matter here.

It should be noted also that the waking reactions in the brain volume are different for different positions of the body, particularly when the subject is lying down. These differences and their causes are not important in this connection. I must leave them together with a more detailed study of the Traube-Hering wave, sleep and other more physiological matters for further treatment. In truth, what I have said here of vasomotor control in the brain is practically an extract from a more extended article on the brain circulation to appear in the future.

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The Rate of the Heart and Breathing.

In the first experiments designed to test the changes in heart rate, use was made of a Sommer sphygmograph on the left wrist. This was connected with a piston recorder writing on the kymograph. A parellel record was taken from a finger of the same hand, using the finger plethysmograph with a piston recorder. But, since it was found that there was no appreciable difference between the heart rate as measured from the plethysmograph curve and as measured from the sphygmograph, the latter was omitted in the later experiments and either a finger or a Hallion-Comte plethysmograph tracing measured for the rate. A pneumograph was applied as usual in the later experiments; no breathing record was taken in the earlier.

A long extension paper was used with the Zimmermann kymograph mentioned above. In a vertical line with the piston recorder needles and the electric marker used to indicate the stimulus, another electric marker wrote the time in one-fiftieths of a second. It was run by a current interrupted by a tuning fork. The drum revolved quite fast, so that the record of the time marker could be easily read. The subject was seated in one dark room, the recording apparatus placed in the other as before.

The subjects were Professor Pillsbury, Mr. Bayley, Mr. Jackson, Mr. Schottstaedt, and Mr. Wright. Mr. Jackson was an advanced student in psychology. Mr. Schottstaedt was just beginning his work in the department.

To study the results, the points at which the upward stroke of the pulse beats began were carefully marked, and lines drawn through these points perpendicularly to the time line. When necessary, correction was made for the displacement due to the movement of the recorder needle in an arc; but this error was usually found so small as to be negligible. The length of each pulse was then counted in one-hundredths of a second, since it was possible without difficulty to estimate as near as one-half the distance between the one-fiftieth of a second marks. The errors are believed to be very small, almost never more than one unit, and such an error is of no importance in the face of the changes which the heart rate shows.

These results were then plotted upon co-ordinate paper with a heavy reference line ruled horizontally through the middle and lighter parallel lines drawn approximately six mm. apart on each side of this. There were similar lighter lines vertically across the paper. The standard line was given the value of either thirty-five, forty, forty-five or fifty one-fif-

tieths of a second (represented as P 35, P 40, P 45, or P 50 at the left end of the line) and each unit of distance along a line vertical to it means one one-fiftieth of a second. Above is positive, below negative to the standard. Units of distance along it represent pulse beats. Points were placed in the appropriate positions on the vertical lines to mark the length of each pulse in one-hundredths of a second, and a smooth curve drawn through these points. A rise in the curve, therefore, means an increase in the length of pulse, or a slower heart rate; a fall in the curve means a shorter pulse, or a faster heart rate. The points at which stimuli were given or removed were marked with crosses. At times, a few pulses were so obscured that they could not be counted individually with accuracy, although the record as a whole was good. These were sometimes omitted and the number omitted marked in the blank space on the record; more often they were averaged,— the total time divided by the number obscured. The fluctuations in a portion thus averaged are, of course, lost, but the distance is always small. Such parts of the curve were drawn in a dotted instead of a smooth line.

The breathing record was treated similarly. The lines were drawn through points marking the completion of the inspiration, which could be determined fairly easily. The single breaths were then counted in one-fiftieths of a second and the results divided by 2, 3, or 4 as necessary, that they could be recorded on the chart with corresponding pulse record; the plotted lengths must, therefore, be multiplied by this number to give the true length. The point representing a breath was placed on the pulse line, in which the inspiration was completed. A dotted curve was drawn through these points. The value of the standard line for the breath record is represented along with that for the pulse record at the left end of the line.

All results which were introspectively bad, or which for any other reason were unsuccessful, were rejected and not counted and charted.

The charts are themselves sufficient justification of this method of studying the changes in rate, and show the comparative uselessness of any rougher method, such as counting the number of pulse beats in ten seconds. In the first place, there are often shorter temporary reactions whose character can be seen only by such a method. Again, even the general changes are uncertain if studied less accurately. There are large variations from purely physiological causes, as Lombard and Pillsbury have already shown; and the kind of results one seems to get by any method of averages depends far too much upon where in one of these waves one begins his count. If

the reaction is not large, almost anything can be proved, or seem to be, by starting at the appropriate point. The true character of the process is seen only in charts of this kind.

I turn now to a detailed study of a few typical charts.

B 24 R. Pl. 19. No stimulus was used, the subject reported the record normal and indifferent throughout. It is given to show the character of the changes which may take place from physiological causes and are not to be ascribed to any accompanying mental process. The Traube-Hering wave and the breath rhythm both show distinctly, and there is at first a small rise, later, a small gradual fall of the general curve. Several normal, indifferent records were taken, all showing similar characters. Of course, one may have a gradual rise or fall at any part instead of the one at the end, the other at the beginning as here. In the light of this, much care is necessary to be certain of any conclusion one would draw as to the reaction with a mental process.

P 32 R. Pl. 19. This shows the effect of a voluntary muscular movement. The subject moved his free hand to his face and held it there a few seconds, then returned to the former position. There was no particular feeling to be noted, only the consciousness of an indifferent movement. The result was a short increase in rate followed by a greater but temporary decrease. The curve then returned to normal and is but little affected by moving the hand down to the table again. There was a fall in the volume record at the time of raising the hand.

P 10 R. Pl. 20. Multiplying. The subject pressed a signal key when the problem was solved. Work done without confusion, required some effort. A condition of strain. Some feeling of relaxation afterward. The pulse rate was increased and recovered before the end. There was apparently a slight increase in the first moment of relaxation.

P 18 R. Pl. 19. Multiplying. It required a good deal of effort all through and the subject got the result just at the end of the record. Feeling of strain. It is to be regretted that several pulses at the beginning of the record could not be counted accurately enough to plot, but it could be determined that all were above 40. The pulse rate was therefore increased considerably, more at the last.

J 2 R. Pl. 21. The subject was asked to attend to a faint telephone snarl to get the attention waves. There was no surprise at signals. The feeling of strain was marked, and there was some relaxation at the end. No other feelings were present. The rate was decreased on the whole. The first large waves were in all probability Traube-Hering waves in the rate, which were partially stopped as the rate was slowed. There was a small increase in rate after attention ceased. The breathing was markedly shallower.

B 4 R. Pl. 20. The subject was asked to count the closely written marks of a time record. Normal before. Considerable effort of attention. Strain was the only feeling, some relaxation afterward. The pulse was slower. There was an increase in rate after attention ceased, and apparently a large wave was coming in as the record stopped.

J 8 R. Pl. 21. The conditions were similar to those of B 4 R. The feeling was strain followed by relaxation. There was a marked temporary increase in the heart rate followed by a more lasting decrease and a gradual increase afterward. The breath wave in the pulse was less marked during the attention. The breathing became more rapid and shallower.

P. 28 R. Pl. 22. A telephone snarl was decreased in intensity until one could hear it at times but not continuously. When the subject was again in a normal, indifferent condition, the kymograph was started,

and, at a signal from the operator, he attended closely to the sound, pressing a signal key with a finger of his free hand while the sound was audible, releasing the key when nothing could be heard. As soon as the paper had run around once, the kymograph was stopped and the paper dropped so that another curve could be taken. The subject attended continuously. After a few minutes the drum was again started, and when it was about one-half way around, the subject was signalled to cease attending. The paper was allowed to complete its second revolution. A record was thus obtained of the heart rate at the beginning and end of a long continuous effort of attention. The two periods are marked "1st run" and "2d run." The subject reported that it required a concentrated attention, feeling of strain. There was a feeling of "letting down" relaxation afterward. The pulse length was not changed at first, but increased in the latter part of the first run and still more during the second run. There was a temporary increase of rate at relaxation. The Traube-Hering wave in the rate, present in the normal, was almost crushed out with the increase in heart rate during the attention, and apparently was coming in again as the second record ended.

J 20 R. Pl. 22. The arrangement was similar to that in P 28 R, except that the problem was to differentiate two weak sounds. The subject reported that he was indifferent before the stimulus, there was no surprise at the signals, attention was close, with feeling of strain only, and there was distinct relaxation when signalled to cease attending. The pulse rate was very little changed during the first run, perhaps a little decreased. It was faster in the second run, and became slower during relaxation with one large wave just after the stimulus ceased. The Traube-Hering wave was present throughout, but was most marked in the normal and first few seconds of attention, less prominent later. The breath wave in the pulse was smaller during the stimulus. The rate of breathing was somewhat increased, and the amplitude distinctly decreased, particularly at first. It will be noted that there was a wave in the breath rate which suggests in its period the Traube-Hering wave found in the volume. I shall call this the Traube-Hering wave in the breath henceforth, without here discussing its nature. This wave is large in the normal part of the record under review, but is more or less broken up during the stimulus period.

J 7 R. Pl. 22. This again was a long continuous concentration of attention but this time visual,—the effort was to count the closely written marks of a time record. The subject moved the fingers only a very little to mark the number of marks instead of pressing a signal key. In other respects the experiment was conducted as in the long anditory attention tests. The subject was normal before, and reported no surprise at signals, constant attention with feeling of strain, and relaxation after the signal for the counting to cease. The heart rate was not definitely changed during the first run, but had increased in the second run. There was a temporary increase in rate at the first period of relaxation. The Traube-Hering wave in the heart rate was distinct in the normal and stimulus periods, uncertain during relaxation; the breath wave more prominent in relaxation than elsewhere. The breath rate was greatly increased in the stimulus period, less in the second run. One longer and deeper breath will be noted just before the end of the first run; a larger breath wave in the pulse rate accompanied it. The amplitude of breathing was greatly diminished during attention. Traube-Hering in rate of breathing was largely obscured.

B 17 R. Pl. 23. The subject took chocolate into the mouth with very

little movement or disturbance. The taste was very agreeable. There was no strain, excitement or other feeling to mention, simply the agreeable taste. The pulse rate was greatly increased. The Traube-Hering wave present in the normal was less in the first part and disappeared in the last part of the stimulus.

P 48 R. Pl. 23. Chocolate. The subject had held the candy between his teeth in a slightly strained position before; otherwise normal. The taste was agreeable, there was a little relaxation from the slight strain, no excitement. The rate of the heart was increased on the whole and the Traube-Hering wave became more prominent than in the normal. The breathing was very little changed, there was less wave in it in the later period.

J 10 R. Pl. 23. Chocolate. Agreeable. There was no disturbance nor other feeling than agreeableness. The pulse rate was increased and more of an undulation came into the curve. The breathing became faster on the whole, but with enormous waves.

P 49 R. Pl. 24. Quinine was taken into the mouth with very little movement. It was very disagreeable; possibly a little excitement; but that very slight. No other feeling. The pulse rate became much faster. The large Traube-Hering waves present in the normal were almost crushed out during the reaction.

J 3 R. Pl. 24. The stimulus was quinine. There was a little surprise when the signal was given to take the quinine into the mouth. The subject reported that the taste was very disagreeable, and that was all there was to the feeling. The pulse became faster and the Traube-Hering wave in it less marked. The breathing also was quickened, the exact character of the undulation in its curve is uncertain.

J 15 R. Pl. 25. The stimulus was lively music played upon a zither. It began at the cross and lasted the remainder of the record. The first strain was not particularly agreeable because too loud, but later the music was exhilarating (exciting) and agreeable. The pulse rate was increased and the Traube-Hering wave in it gradually eliminated. The breathing became faster, the wave in its curve was of uncertain character. The amplitude of breathing was somewhat less during the stimulus.

P 41 R. Pl. 26. Music, very pleasant and exhilarating (exciting). The pulse rate became faster and the prominent wave in it somewhat less. The breathing was also more rapid during the stimulus. There was a large wave in the breath rate, the relations of which are not very evident.

P 43 R. Pl. 26. The stimulus was again music of an agreeable exciting character. There was possibly a little strain. The pulse was shortened, particularly in the latter part where the agreeable excitement was greatest. The first part of the curve shows what changes may take place without accompanying mental processes that will explain them. The Traube-Hering wave in the heart rate became less prominent during the reaction. The breathing was on the whole somewhat faster with the music.

P 45 R. Pl. 26. Music was again the stimulus, this time pleasant and markedly depressing. The pulse rate was increased, as was also the rate of breathing. The undulation is not very noticeable in either.

J 16 R. Pl. 27. The stimulus was pleasant and depressing music. The pulse rate was faster, the wave in it less marked during the stimulus. The breathing was also more rapid with the music; the Traube-Hering wave in the breath rate is fairly well shown, somewhat less in the reaction.

S 9 R. Pl. 25. A yellow light was turned on at the first mark, off at the second. The subject reported that it was agreeable to a certain extent

in contrast with the darkness, but that the color was not agreeable. Its disappearance was hardly noticed. The pulse was slowed and the breath wave in it more prominent. Very few records were taken with this subject. Two like results were obtained from him by use of a pleasant exciting violet light, and one with the depression from turning off a light. No determinable change occurred with a long effort of attention. An increase in rate accompanied one multiplication test. Two strong shocks with an unexpected whistle and one very irritating light gave faster rate. The subject was unaccustomed to this work and almost always reported that he was "expecting the stimulus." Most of the reactions were probably a release from strain, and have little meaning as accompaniments of the mental process coming into an indifferent state. It was perhaps a mistake that few lights were used as stimuli with the other subjects and only three cases were counted. But they were omitted because they had no effect to speak of, only a suggestion of an increased rate in two of the three cases.

P 38 R. Pl. 27. A loud, unexpected whistle was blown. The subject was startled and jumped. It was disagreeable, exciting strain. Recovered very soon. The pulse rate was temporarily increased, then temporarily decreased, after which it returned to normal. There is a large Traube-Hering wave in the latter part of the normal period, and possibly throughout the remainder of the record. The breathing was made more rapid for a short time.

J 21 R. Pl. 28. The stimulus was again an unexpected whistle. It frightened the subject. Excitement, disagreeableness (and strain?). The general result was a faster pulse for a time, the breath wave in it being a little less marked in the reaction. The breathing became faster for about the same period that the heart rate was increased.

B 10 R. Pl. 28. A particularly sorrowful event in the experience of the subject and to which his attention turned easily was suggested. He reported that he was normal before, that a few seconds after the suggestion was made he fell into a distinctly sad mood, and when told to return to his former indifferent attention he could feel his body drooped, one might say relaxed. It was, apparently, a condition of disagreeable depression for the most part, with perhaps a very little strain at the start, although the subject did not give an accurate account of the feeling directions involved. The pulse rate was slightly decreased, but the difference was not enough to have any meaning. The more important point is the marked Traube-Hering wave which came into the curve.

About one hundred and ten records were counted, charted, and then tabulated by the same methods used in the work on volume changes. Such a study of results showed that the strain of expectation tended to increase the pulse rate. Movement in two tests increased, then decreased it. Multiplying, which was accompanied by a feeling of strain only, gave a marked increase in three cases, no decided change in three. With short close auditory attention there was a decrease in two tests; in a third, no change at first, increase in the latter part. Similar visual attention had as its accompaniment a decrease in rate, twice, a temporary increase followed by a decrease, twice. At least one of these increases was probably caused by movement of the subject as he began attending. Long, continuous visual attention gave in three cases a decrease in rate at first,

followed by an increase later; in two no change at first, increase in the second part; in one there was no change except a slight increase from a movement at the beginning. Long auditory attention caused no change, once (with subject S, mentioned before); a short increase followed by a decrease in the first part and increase in the second part, once; slower rate at first, faster later, in two instances; and three times, no change at the beginning, quicker beat in the latter part of the first run and in the second run. Of eight results with chocolate, in seven of which agreeableness was pronounced the only feeling to mention, seven gave increased rate, generally very marked; one gave a short decrease followed by a more prominent increase. There were five records of a disagreeable taste, in two of which there was also a little excitement,—all showed more or less marked fall in the curve. There were seven trials of music which according to the subject's introspection were agreeable and exciting. All resulted in a faster rate, generally the increase was very marked. The emotion of joy, which was almost entirely agreeable excitement, was accompanied by a quickened heart in one case, no change in two. Omitting one instance which was obscured by the effects of movement (the subject was not prepared) there are left four cases of agreeably depressing music, in all of which the pulse was shortened. If we except the results with S which were uncertain, the rather disagreeable depression from suddenly turning out a light caused an increase in rate in four tests, no change in one. Four records were taken with the emotion of sorrow, none of which showed a determined change of rate. The same was true of two with the emotion of anger. Eighteen records were retained, in which the stimulus was a loud unexpected whistle. The stimulus induced a shock, disagreeable excitement with more or less strain. Two of these experiments showed no change; eight gave a faster pulse rate; and eight resulted in a temporary increase in rate followed by a decrease which was generally small, and later returned to normal. The main change during the feeling of relaxation was a slowing of the pulse generally, but this slowing was in perhaps half the tests preceded by a temporary quickening in the first moments of the "letting down" feeling.

It will be noted that there were only four conditions under which a slowed pulse was obtained. We have already discussed and rejected as meaningless because complicated by release from nervous strain, the experiments with colored lights when S was subject. A second condition is in relaxation, when the change is little more than a reaction back to normal added to any effects of fatigue. The whistle in the third place caused a secondary slowing. There seems to be a tendency to

both acceleration and inhibition with these strong stimuli; and the rule is that the acceleration is stronger at first, the inhibition, a little later and this decrease in rate is generally small, and is often absent. In fact, the effect of such stimuli upon the heart rate is not nearly so marked as might be expected, not so much as that of the more lasting weaker stimuli, and is not at all in proportion to the effect on the volume. Of course the increase in rate may be due either to inhibition of the vagus nucleus of excitation of the accelerator centre.

The fourth type of decrease in heart rate, that with sensory attention, requires more notice. It is not the reaction to the feeling of strain which is so evidently present. For in the first place, this feeling was fully as strong and as pure in the multiplication experiments, and these gave a shortened pulse. Again, in all except two cases (in which there was no change) of longer effort of attention to both auditory and visual stimuli there was an increase in the rate above the normal in the second run, and in several cases this occurred before the end of the first run. And at least five records showed no slowing at first, the quickening was only delayed. These facts suggest that the real tendency of the effort of attention, the strain shall I say, is to shorten the pulse, and that this tendency is held in check at first by some other factor which tends to lengthen the beat. And at least an indication of this second factor is readily found. It is here in sensory attention, particularly in the earlier part, that one finds by far the most effective decrease in amplitude of breathing, and this generally goes with a much smaller increase in the rate of breathing than is caused by many other stimuli; it may even be decreased. The natural results of this both indirectly and directly by the lessening of the cumulative effect of the respiratory centre upon the vagus would be to lengthen the pulse. No experiments were designed to test this consequence of breathing changes directly, but a measurement as careful as possible under the conditions made upon curves taken for another purpose showed such a pulse change.

No difference was found between visual and auditory attention. There was no difference between agreeable and disagreeable conditions.

A few changes in the Traube-Hering wave in the heart rate have some significance. Agreeably exciting and agreeably depressing music, disagreeable tastes and the disagreeably exciting whistle, tended strongly to eliminate the wave, never increased it. Agreeable taste is ambiguous, twice increasing and twice decreasing it. One of these increases with agreeable taste was accompanied by large variations in breathing. Sorrow, with slowed and irregular breathing, exaggerated the Traube-Hering in the pulse. Strain in attention lessened

the wave during the stimulus; it usually returned in relaxation, and in some cases was markedly increased then, a phenomenon which may perhaps be connected with the less aerated blood.

The rate of breathing was almost always increased; in smaller degree for sensory attention than for any other stimulus. Indeed, two cases of sensory attention showed a temporary decrease in the breathing rate preceding the increase, one, gave a distinct decrease and one no change. No other condition was accompanied by a decreased rate.

Each of the original records on which the plethysmographic tracing was clear enough to show the volume changes of the Traube-Hering wave was carefully studied and the highest and lowest points of volume marked. The corresponding lines were then designated in the pulse length charts by the abbreviations T= trough and C= crest. These abbreviations were placed under the curve to which they refer. An examination of these results showed that the crest of the volume wave may fall anywhere on the rise of the pulse-length wave, more often near the crest than near the trough; that the trough of the volume wave may fall anywhere on the descent of the pulse-length wave, but still more often near the trough than near the crest. So that the fall of volume will correspond with a part, commonly the smaller part of the rise in the pulse-length curve, and with a part, still more commonly the larger part of the fall of the pulse-length curve. The rise in the volume will correspond with a part, generally the smaller part of the fall of the length curve, and a part, less generally the larger part of the rise in the length curve.

I have spoken above of a Traube-Hering wave in the breath rate. Perhaps it should not be given this name, for I cannot be certain of its relations, and, in any case, it is much obscured by more or less voluntary influences. But such a wave in the breathing is often found during sleep, and this fact naturally suggests that a similar relation may play some part here. I must, however, leave this also for a fuller treatment later.

An Introspective Report and Conclusions.

The subjects were, in general, asked to classify the mental states in terms of strain, relaxation, excitement, depression (rest), agreeableness, disagreeableness, rather than to give an account of the more intimate nature of these processes. Yet some effort was made to get at the matter more closely. If it is unsuccessful, it may at least be suggestive, and may emphasize the need of a more careful study of the introspective side.

Strain is described as composed of sensations from the muscles, the backflow from the acting muscles, particularly those

of accommodation of a sense organ. But so is excitement also. Possibly other organic sensations are more involved in what is often called a state of excitement. It is reported of a stimulus that it "kept me on edge all over," "seemed to stir every spot of the body." A condition reported as excitement seemed afterward to be "an indefinite, uncertain, muscular strain." "Felt tingling all over." It may go only so far as to "wake one up," give an increased sensation of muscular tonus.

These analyses, particularly of excitement, are made only after the original experience, or as the stimulus is ceasing. So it is reported after a whistle; "Every shiver seemed to rush in at once, then relief." Relaxation after strain was described as "the receding and more or less indefinite reverberation of the feelings during attention." It is useless to quote many of the introspections. In short, both strain and excitement are analyzable into organic, particularly muscular sensation for the most part; of course, the sensations aroused directly by the stimulus, as the noise, are also involved. When so analyzed, they lose their character as feeling, we have something else; but that is another matter. Yet there is a difference. Strain may be imperfectly analyzed and is felt to be so, as long as it is called feeling; but so far as it is analyzed, every part connects with all others. The whole state turns as a sort of system around a central controlling process. Although not to itself, yet to an onlooker it is teleological as a whole.

In excitement, there are several ends, or several may be read into it; several directions of movement of the strain of consciousness, but none clearly defined and dominant. It is not a closed system of association where every part is associated with every other in its place. It is not the rate of succession of mental processes, it is a half fusion of different lines of association that characterizes excitement. Mutual inhibition may be one means of holding a number of such chains imperfectly in consciousness. Obviously there is no sharp line of demarcation between strain and excitement; such intermediate conditions we find often with a high whistle. It is best to describe the matter this way, rather than to say we have here a mixture of the two.

Relaxation seems to be a release from either strain or excitement. We know the difference in the "letting down" feeling in the two cases, because we feel the difference in the states that are lingering. But in either case, the feeling is a returning from the character of sensation one gets from the active muscles to the kind of sensation from the lax muscle, and partakes partly of the nature of both. It is hardly an opposite of either strain or excitement in the way that disagreeableness

is the opposite of agreeableness. It originates only in a release, is a secondary instead of a co-ordinate state.

Depression, rest, name feelings that at least at first sight seem to have more varied forms. It is, I think, based upon a different kind of sensory content, that from the quiet muscle, or one easily acting. These sensations lack the peculiar quality which we call strain when it is isolated as a quality (not feeling). A different rhythm at least gives it a different quality. It comes to be associated with, to mean a condition of, little or no motion. But this is a secondary factor. The tendency to such a condition may be felt as resistance or not, according to circumstances. Thus, if I am sleepy and can go directly to sleep as I choose, the feeling is one of rest, no active oppression. But if I am attempting to work, or if a stimulus is acting that tends to excite me in any way,— in either case there is a felt oppression, a shutting down upon the activity. Looked at in this way or thought of simply as rest or quietness, in any case it is as much an opposite of strain as of excitement. We cannot have it simultaneously with either strain or excitement, except when felt as oppression, and continued strain as well as excitement gives rise to depression. Yet it is not an opposite of either in the way that disagreeableness is the opposite of agreeableness,— it is simply different. B's introspections at least, bear me out in this report.

The most important introspection bearing on the agreeable-disagreeable phases of experience was that to interrupt suddenly an agreeable stimulus is felt more as a shock than to interrupt a disagreeable. It suggests a view which we may perhaps express by saying that the stream of consciousness, always has a momentum. One status is always a condition for the becoming of the next, even though the next be like the present. There is a character of expectation, or that which makes expectation active as much in a continuous sensory process as in looking for a change. These are only two special cases. Agreeableness is then success, disagreeableness failure, but not necessarily in moving toward some other end. The process is a measure of the ability of one stage to adequately prepare for the next. Perhaps this says little more than that disagreeableness has more in common with the interruption in mental process, the fact which I have noted above, but it is so far suggestive.

I return now to the experimental results. Whether the above considerations are correct or not, I think I may speak with more confidence of the organic reactions. I find that feelings cannot be classified on the basis of vasomotor and heart rate changes. There is no reverse relation even between

the accompaniments of agreeableness and disagreeableness; much less are there three such pairs of reactions. The tridimensional theory would make strain give a lengthened pulse, relaxation a shortened pulse. In these results they give just the reverse, except as the rate with strain is modified by inhibited breathing. Agreeable, agreeably exciting and agreeably depressing states all give distinctly faster pulse and fall of volume. Neither Wundt nor Lehmann can explain this. Wundt would have the exciting and depressing phases produce no change in heart rate, and agreeableness cause a slowed pulse. Hence, in all these three cases, he should find a lengthened pulse beat; and Lehmann's theory calls for the same at least with agreeableness. Both also hold that agreeableness (and Wundt adds excitement) increase the volume,—we find the reverse. And I wish to emphasize also that the brain does not in my results decrease in volume with agreeable stimuli, and the size of the brain pulse does not decrease with disagreeableness. I need not repeat in detail the reactions summarized at the end of each section of the paper. It will be seen, that, if this work is valid, neither Wundt's nor Lehmann's theory can be allowed.

In short, all moderate nervous activity tends to constrict the peripheral vessels and to increase the volume and size of pulse in the brain. All moderate nervous activity likewise increases the heart rate. Strong stimuli cause both an exciting and inhibiting effect, which is seen especially in the heart rate. They also cause a double reaction in the brain. The most marked effects are at changing periods, particularly with an incoming stimulus. Lastly, the activity of any part, or the prominence of sensations from it tends to counteract constriction in that part.

We may explain these results in part, as follows. It is probable that all moderate nervous activity also causes constriction of the splanchnic vessels. Strong stimuli seem to have both an exciting and inhibitory effect upon them. The results in the heart rate may, of course, be due to an effect on both the vagus and exciting centres. The increase in the volume of the brain is probably in part at least due to increased blood pressure from the constriction of the periphery. It is not attention as such that causes the change. It may be simply reflex. It does not seem necessary that the stimulus reach consciousness, contrary to Lehmann's assertion. At any rate, I think this is indicated by experiments during sleep. Local control in the brain at least by constriction is indicated, but I leave this question open for the present. Perhaps the fact that the activity of any part tends to counteract constriction in it is due to the action of vaso-dilator nerves. The circulatory con-

trol depends upon physiological processes that vary roughly with what one is doing.

I append here some references bearing directly on the subjects studied, and most of which have been noted in the text.

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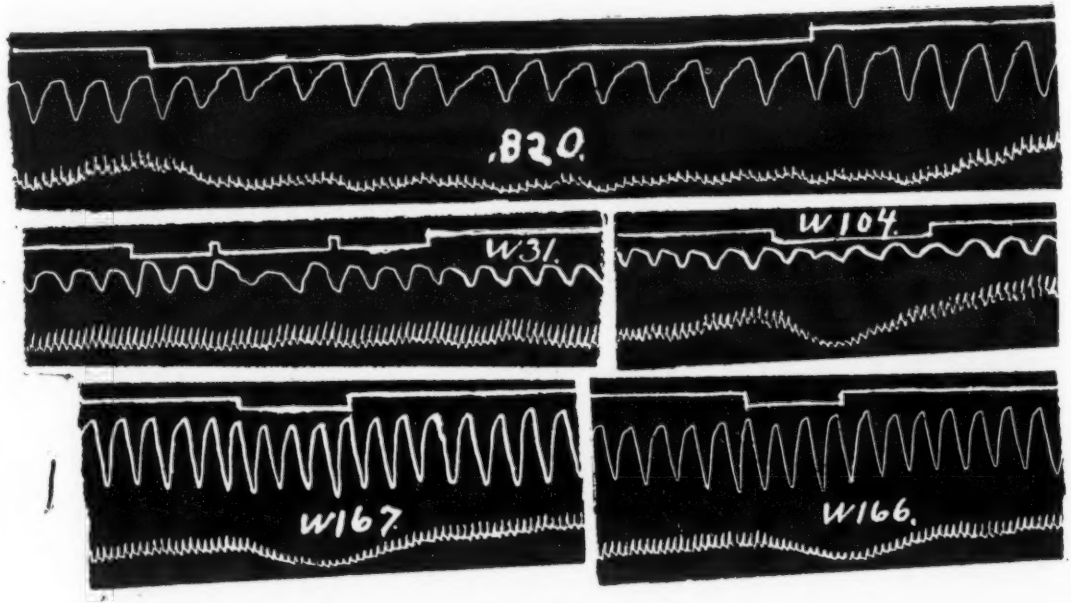

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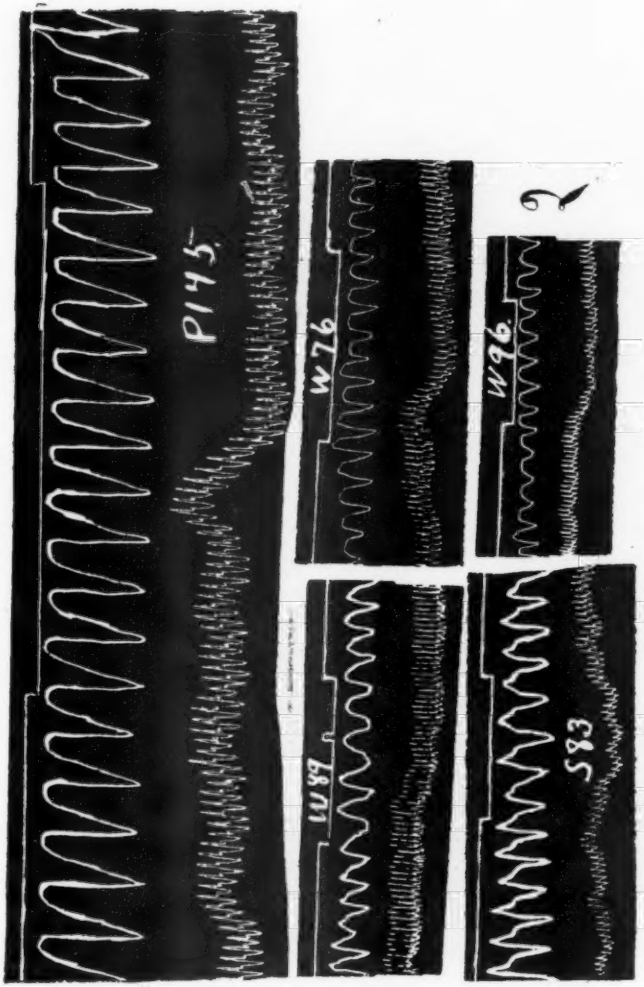

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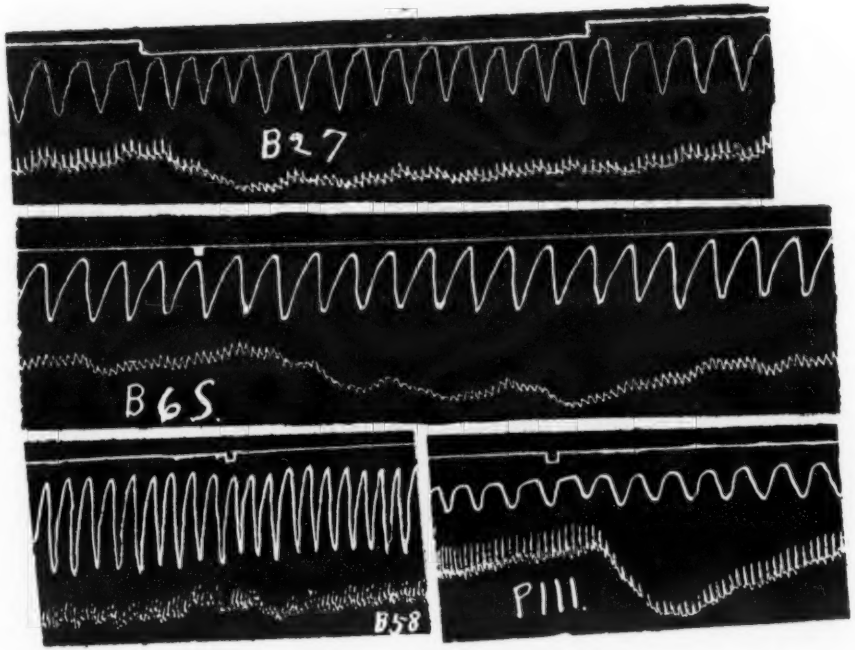

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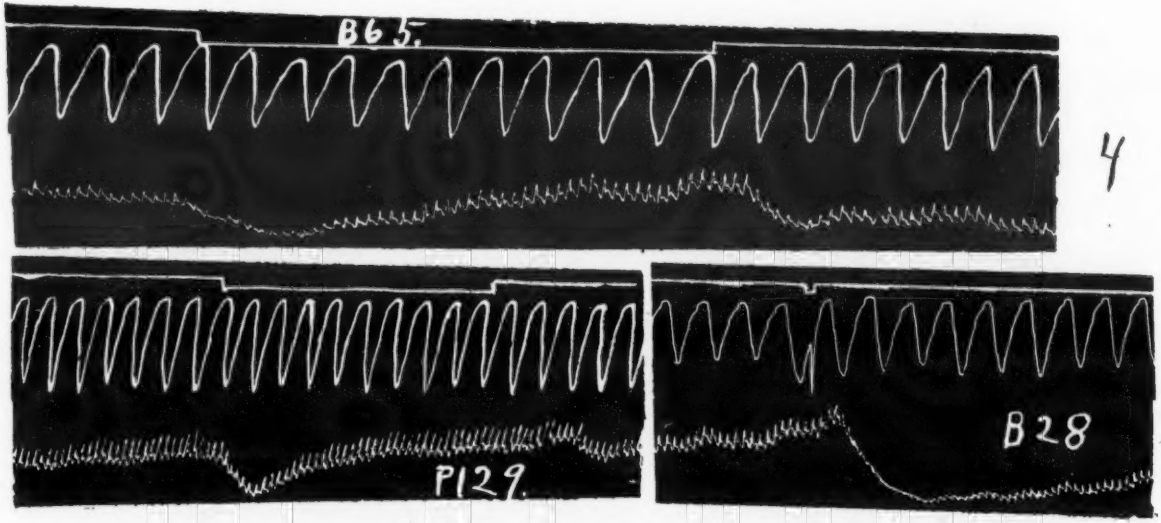

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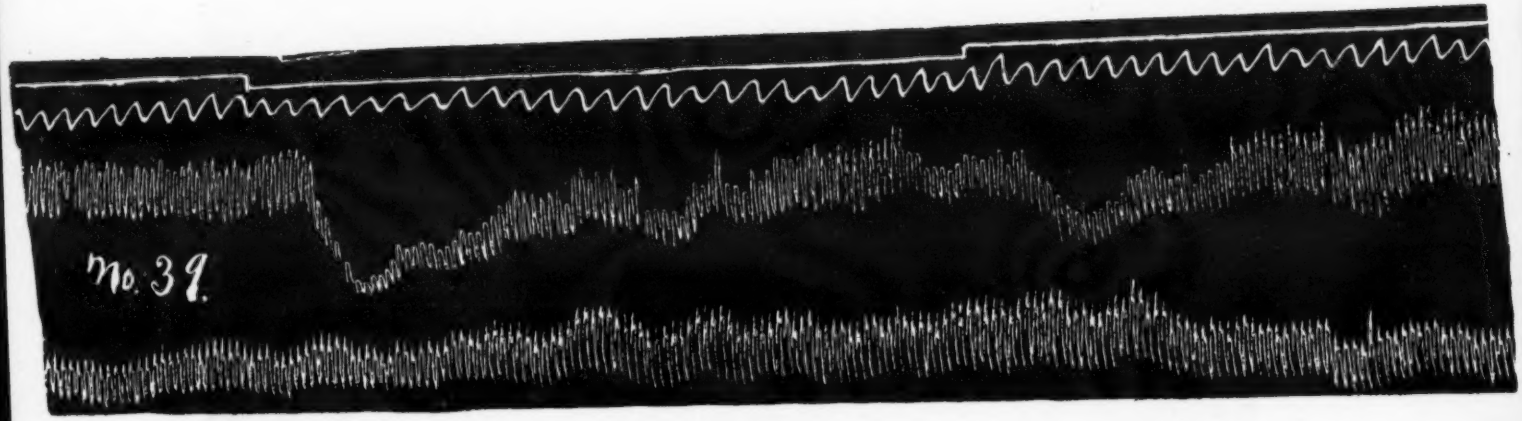

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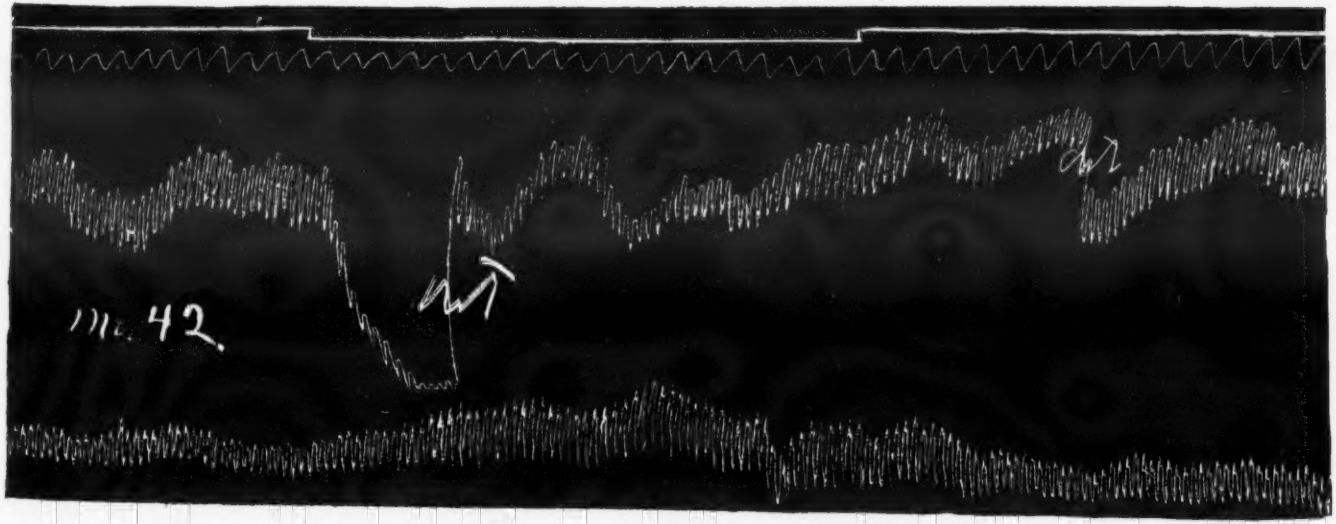

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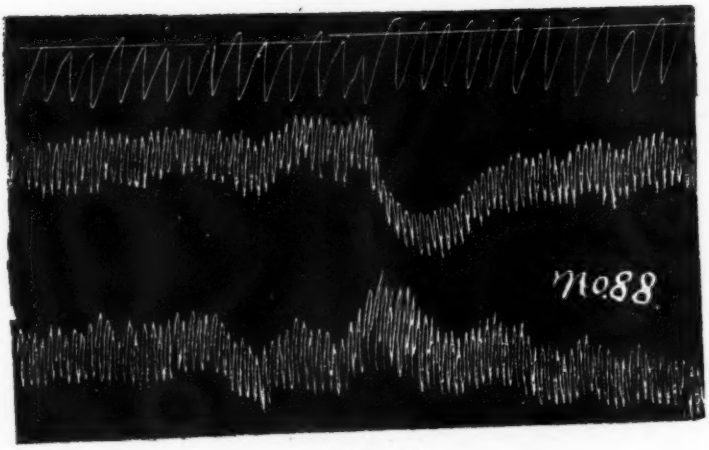

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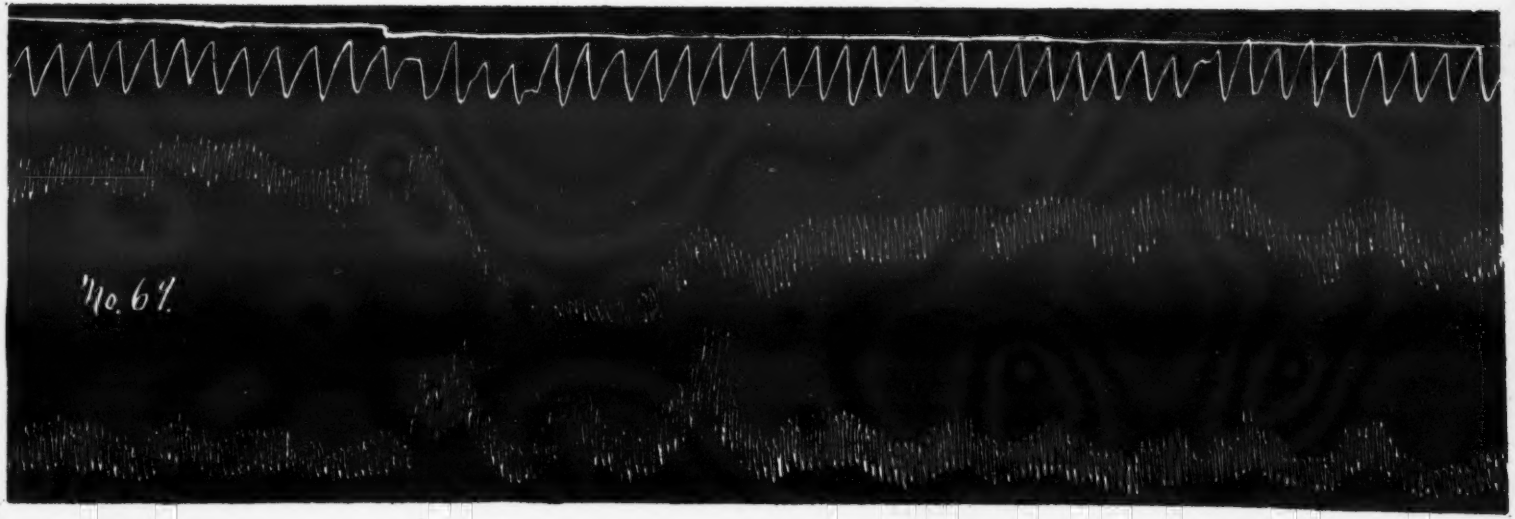

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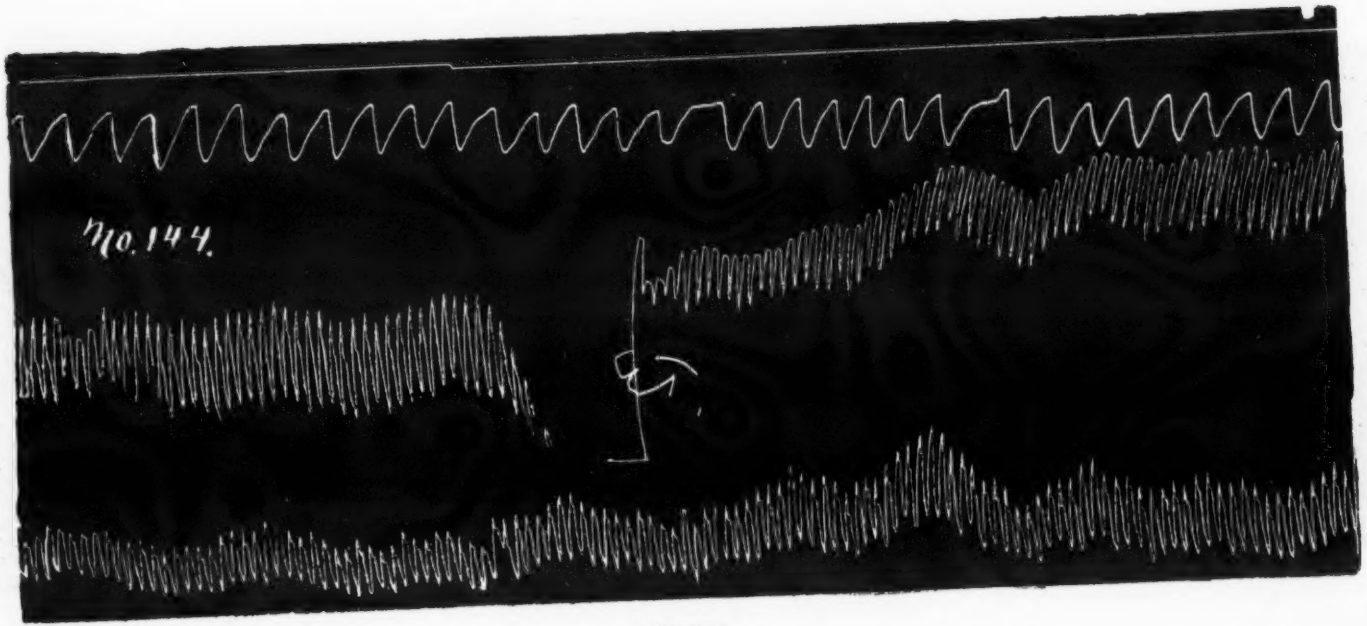

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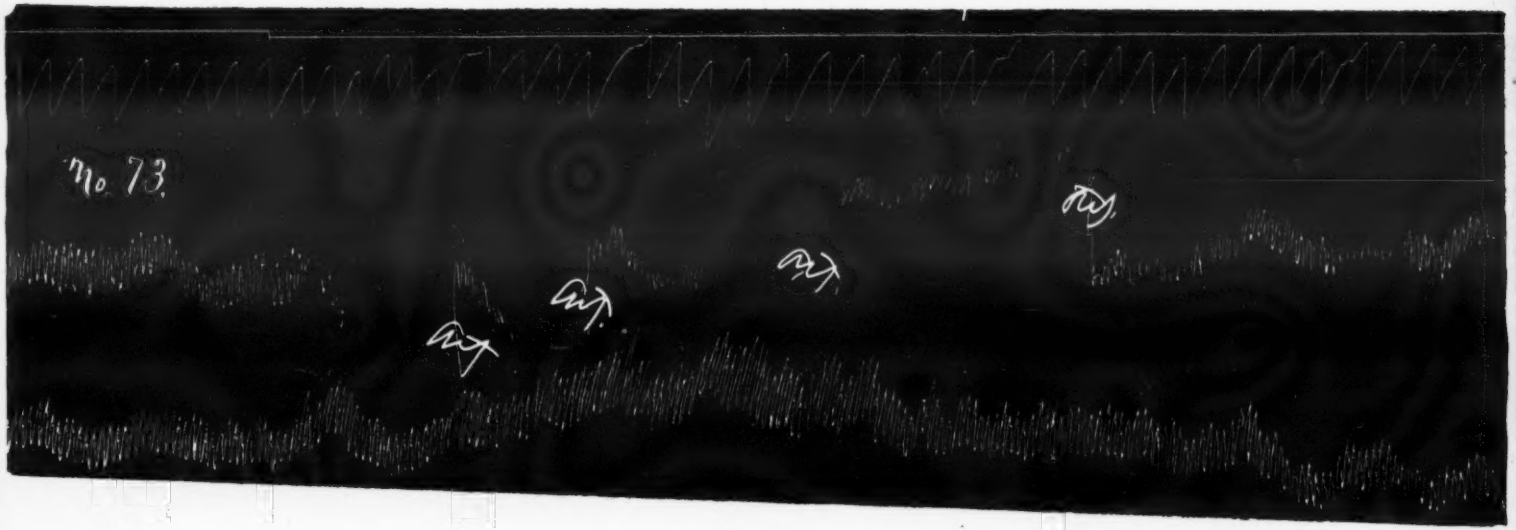

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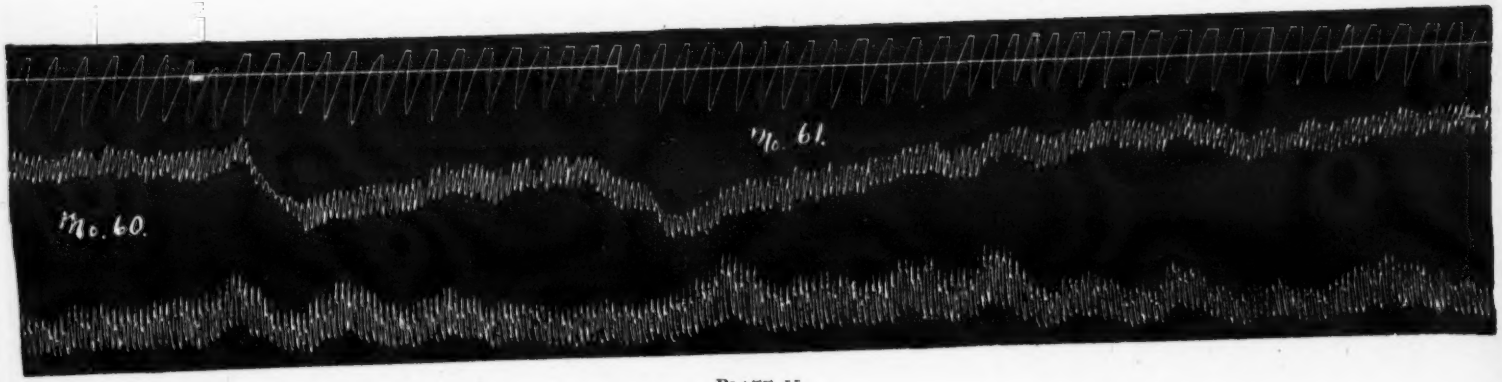

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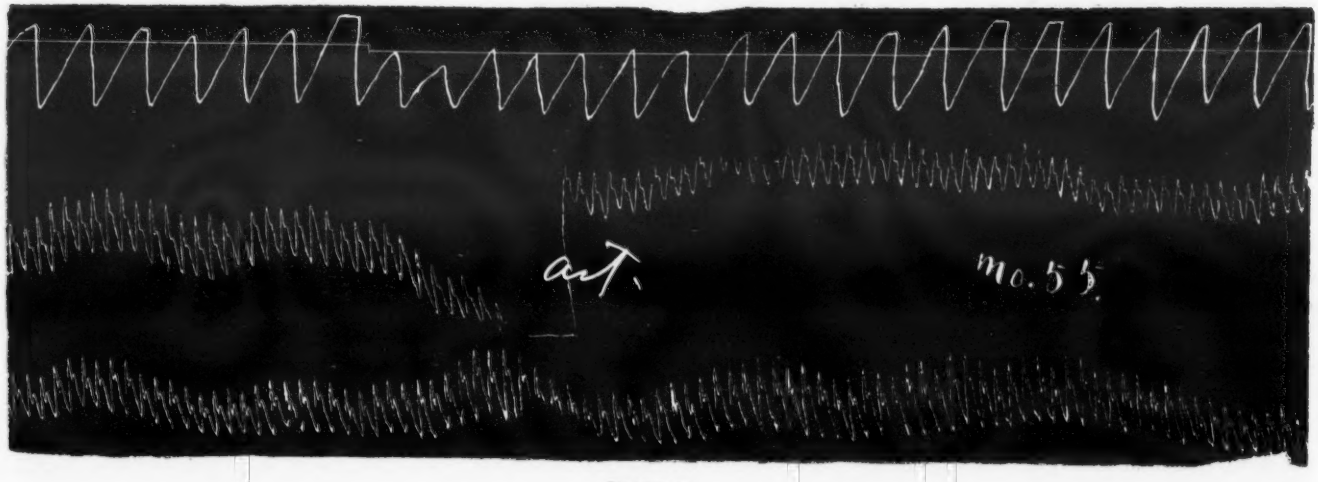

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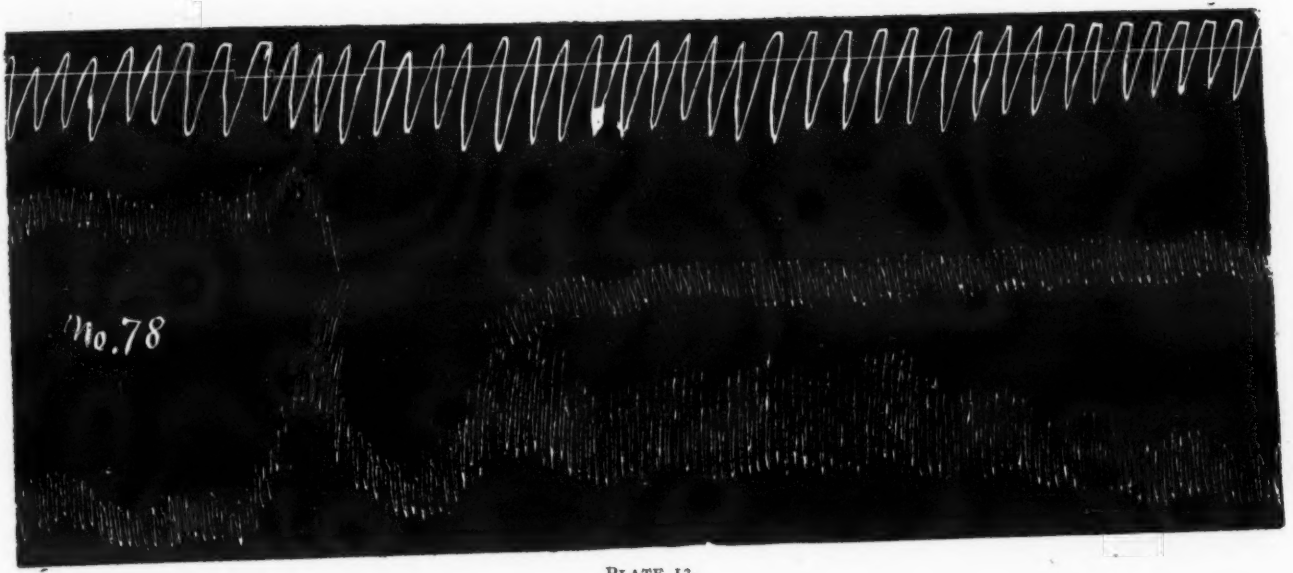

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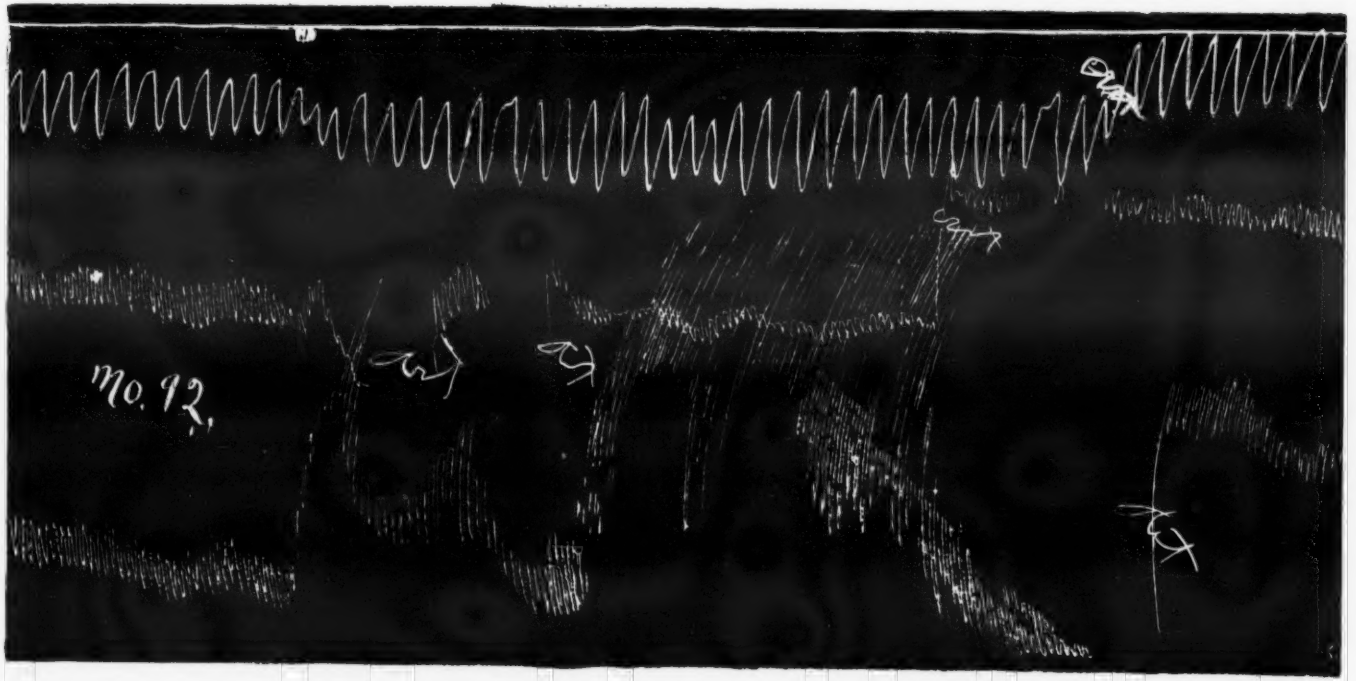

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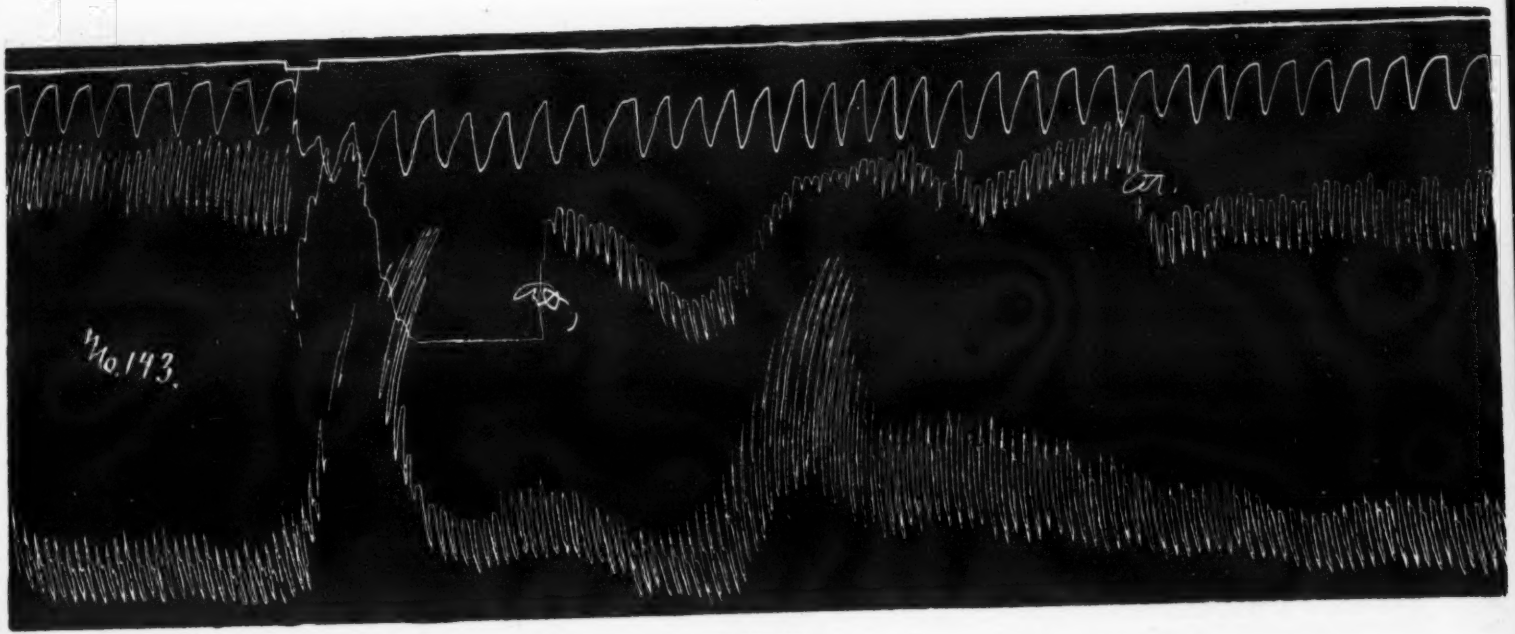

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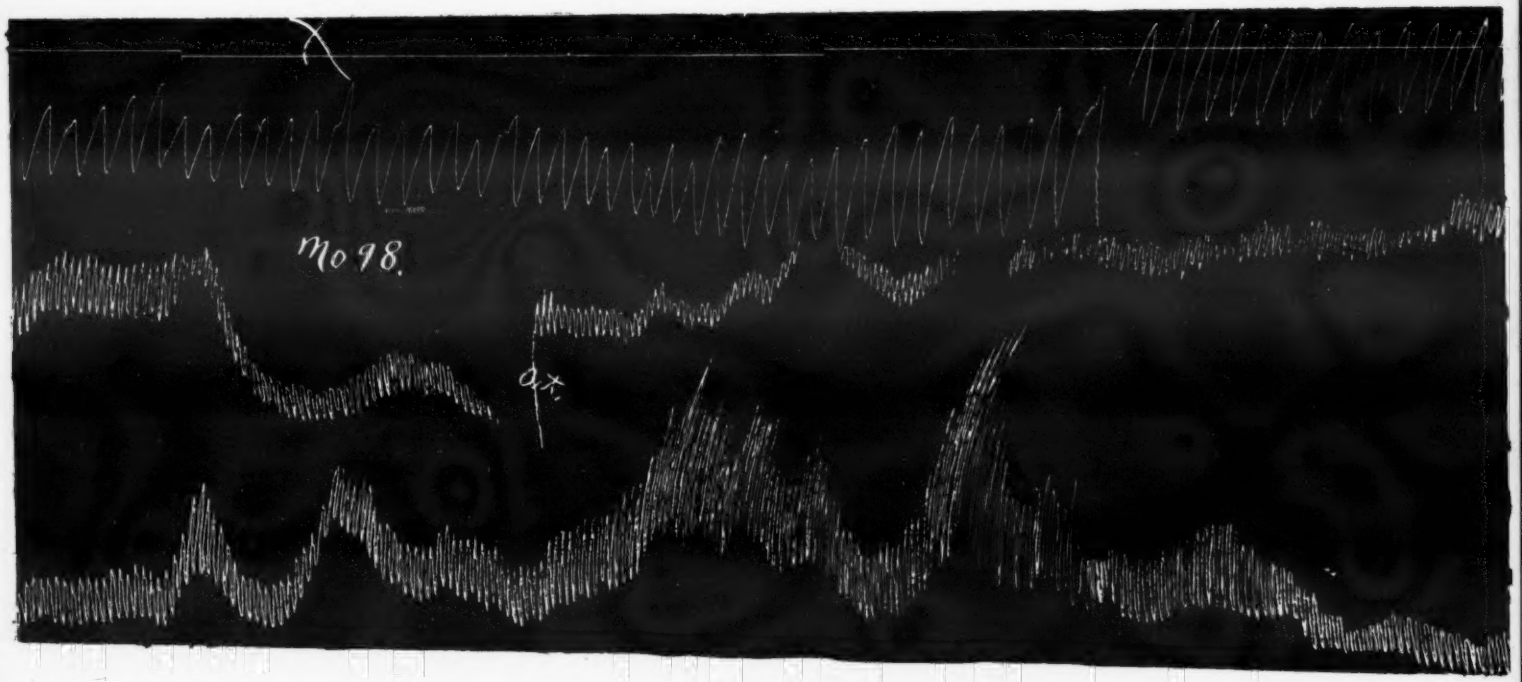

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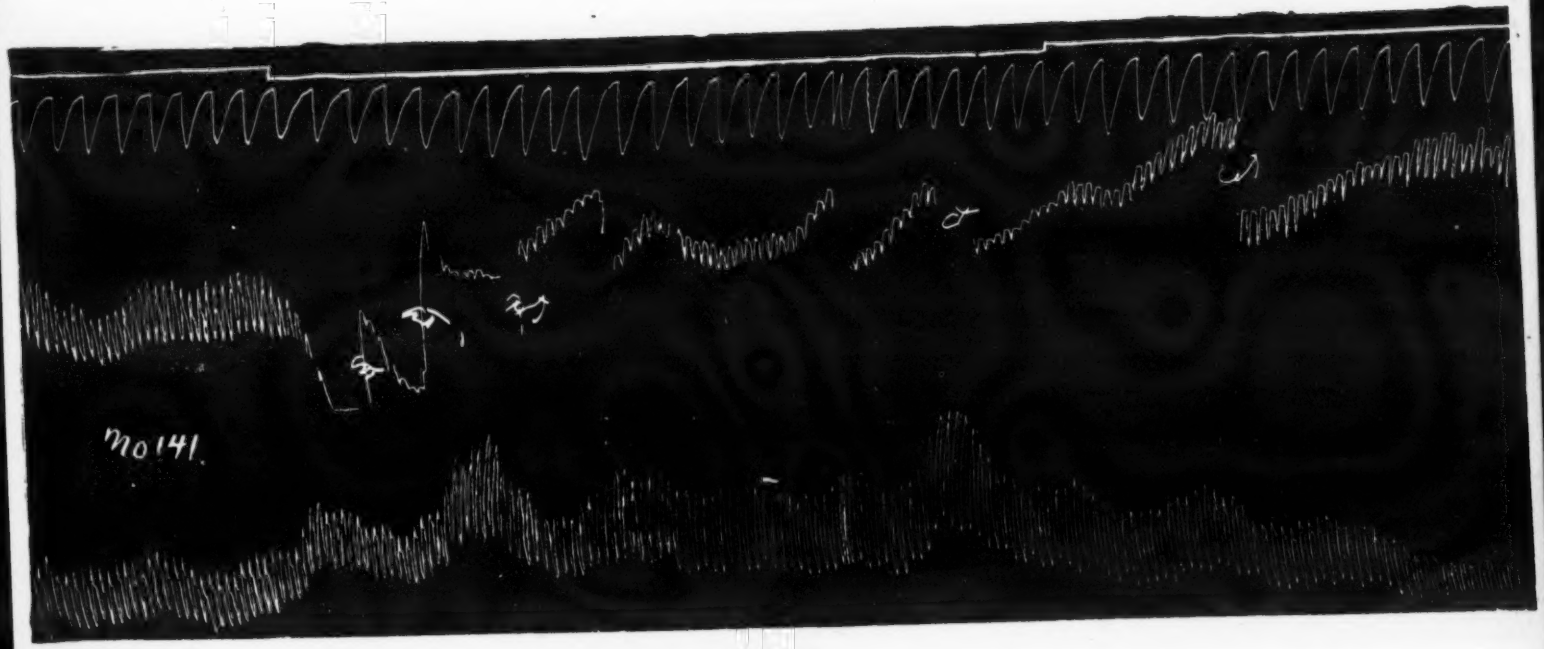

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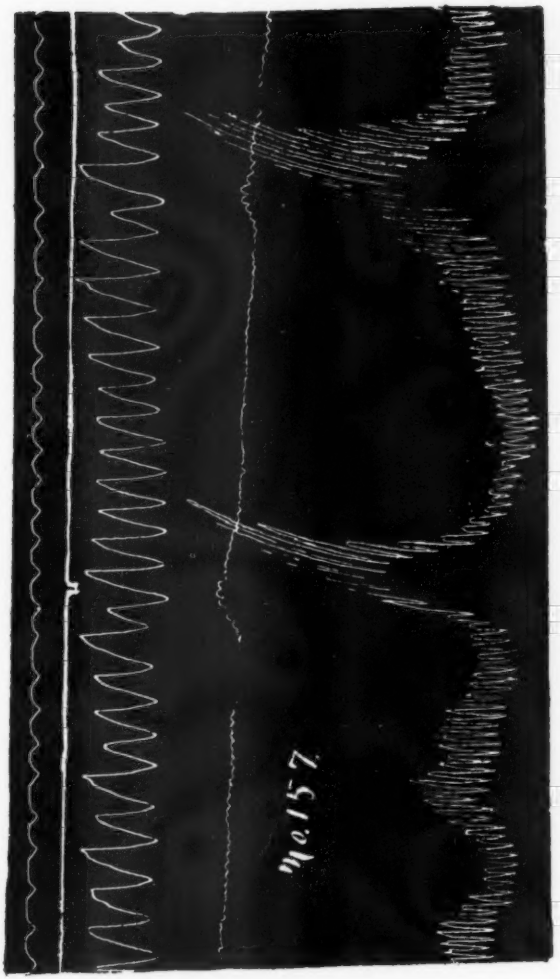

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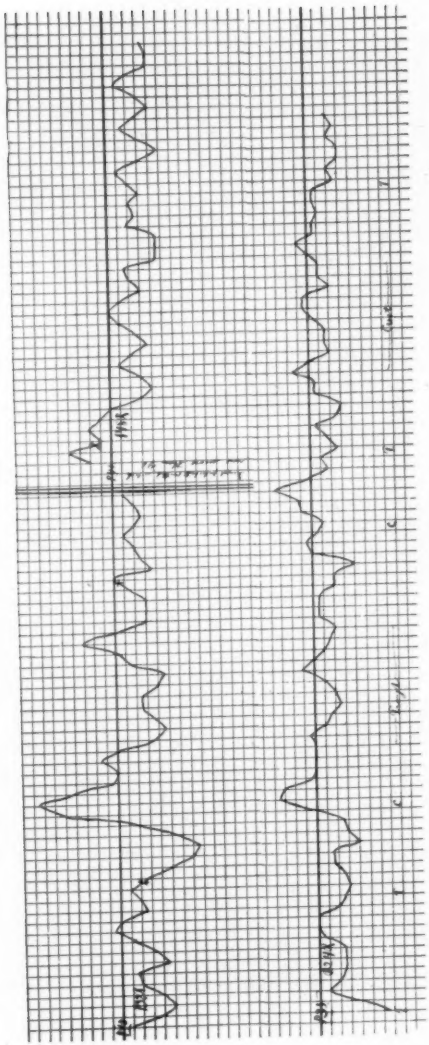

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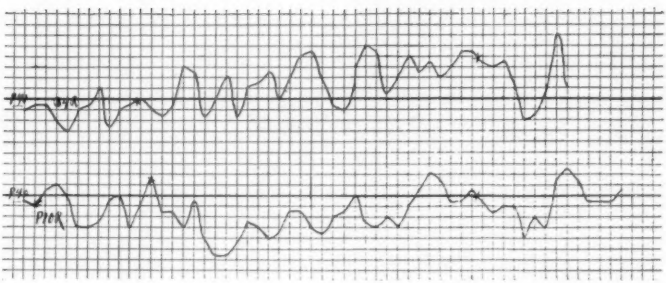

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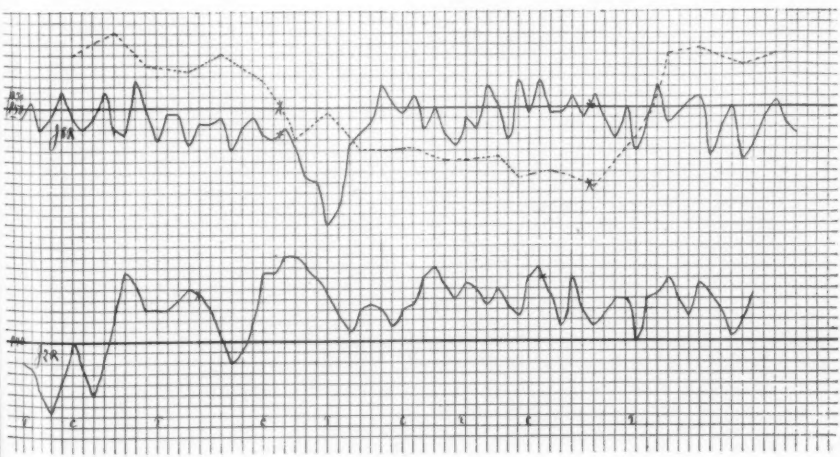

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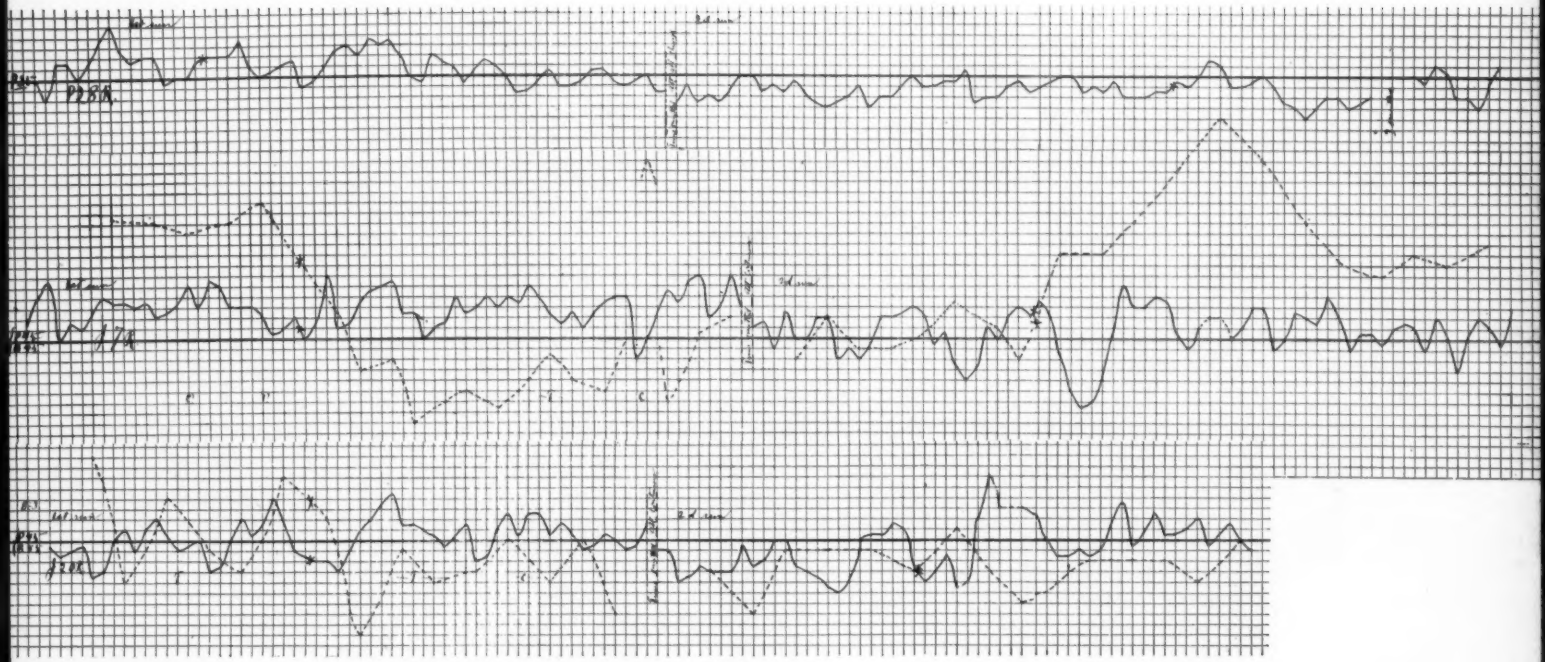

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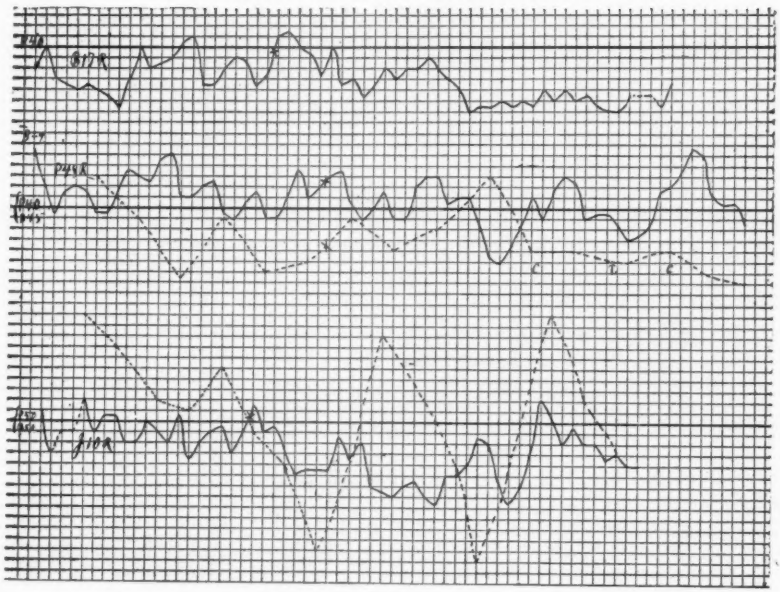

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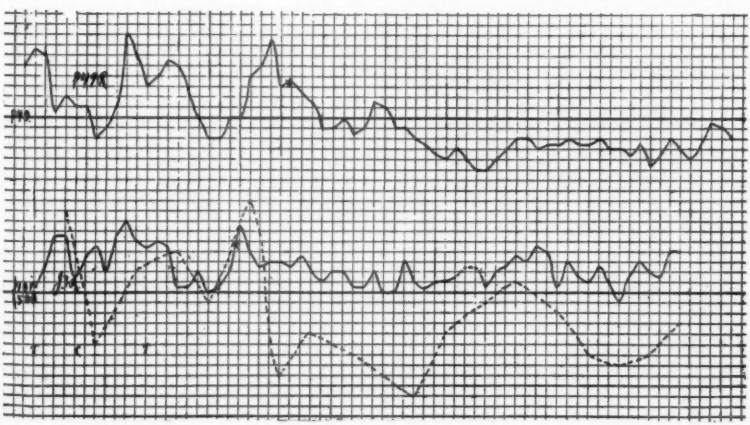

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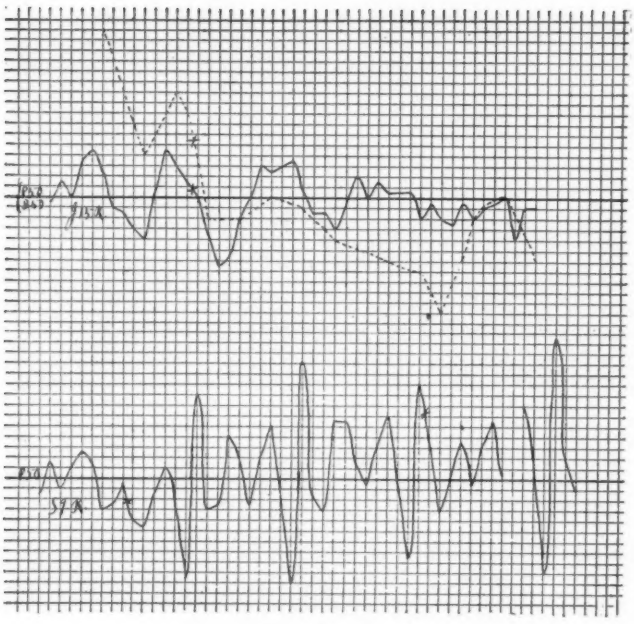

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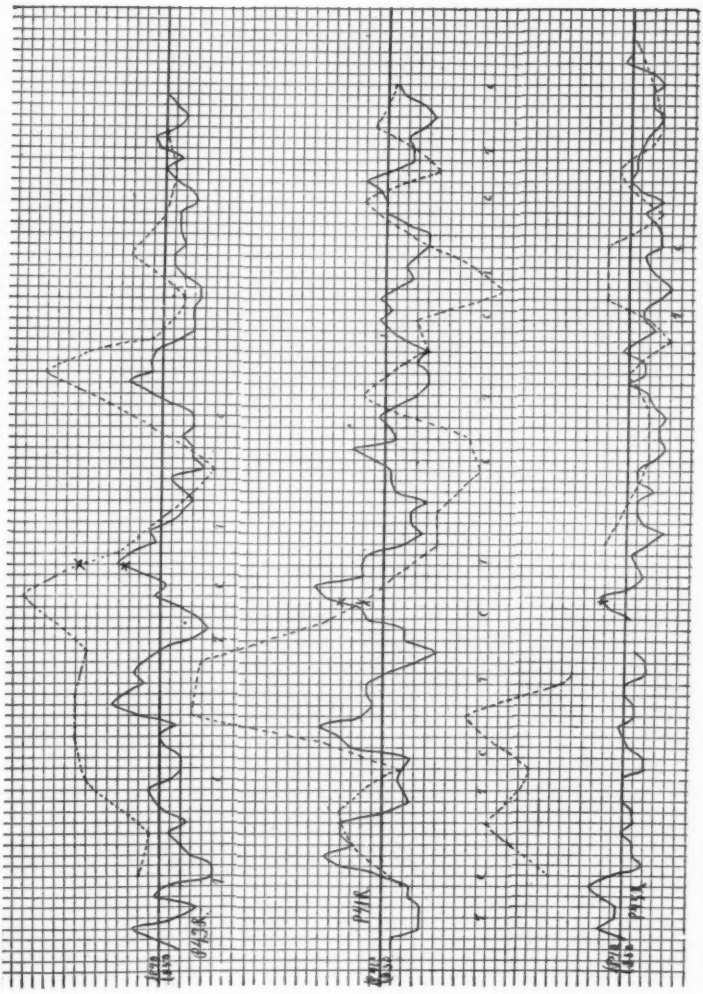

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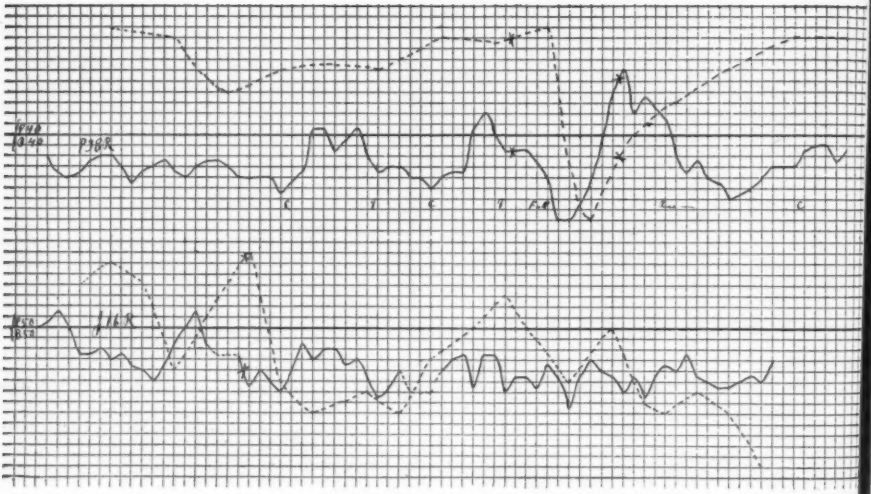

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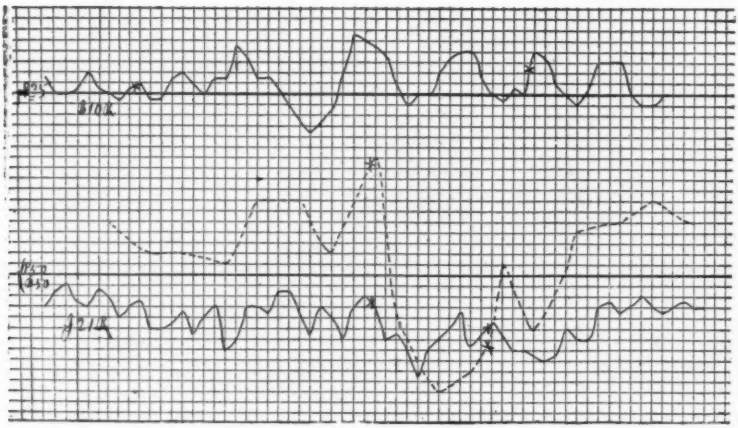

PLATE 28.

PSYCHOLOGICAL LITERATURE.

Experimental Psychology, A Manual of Laboratory Practice, by EDWARD BRADFORD TITCHENER. Volume II, Quantitative Experiments: Part I, Student's Manual, Part II, Instructor's Manual. The Macmillan Company, New York, 1905. Student's Manual, pp. xli + 208. Instructor's Manual, pp. clxxi + 453.

In the field of quantitative psychology English and American literature has been relatively sterile. It would be interesting to determine to what causes this sterility is attributable, but for the present at least, we must forego the inquiry. Meantime in passing it may be remarked that this lack of productivity has been referred by certain presumably competent observers to a deep-seated Anglo-Saxon suspicion of the utility of the results gained by psychopysical science under the Teutonic auspices where it originated. Others have asserted that psychophysics required a larger measure of accurate patience and a broader acquaintance with mathematics than the average psychologist of British or American lineage possessed. Still others of a more amiable mood have assigned as a cause the more urgent appeal made to English and American temperaments by the less technical aspects of psychology. It could hardly rank as a bold speculation were one to suggest a combination of these considerations, together perhaps, with others of like ilk, as responsible for the extant situation. In any case, whatever the reasons, the facts are plain. Psychophysics has been chiefly a continental product and until recently almost exclusively German at that.

In the volumes now before us, Professor Titchener, who completes herewith his series of laboratory manuals, has made the first systematic contribution to quantitative psychology which has appeared in the English language on a scale sufficiently large to do justice to the subject. If it enjoyed no other distinction, this circumstance would entitle the achievement to high regard. But its claims to professional and scholarly consideration are of a more impressive kind. It seems to the reviewer a safe prophecy that these volumes, with the revisions which they are likely to undergo, will form for a generation at least the classical English treatment of the subjects with which they deal. Nor is this judgment indicative of entire agreement with the author upon the positions adopted in the text. It rests upon the breadth and solidity of the work and upon the lucidity of the exposition. One might quite conceivably differ from Professor Titchener on every important point in his books and still cherish the sincerest respect for his accomplishment and the most sensitive appreciation of the service he has rendered English-reading students of psychophysics. Indeed, the reviewer is not disposed to limit his sense of the usefulness of the volumes to readers of this language. How far, however, our foreign colleagues will profit by them remains to be seen.

Before entering upon a more detailed examination of the books and the author's positions upon the great controverted issues of psychophysics, it seems fit to comment upon the monumental labor which has been dedicated to the task of composition. This is the more appropriate in view of the disposition prevailing in sundry quarters to toss off psychological volumes between meals. The literary and

bibliographical completeness of these volumes, together with the ripe and sober estimates which they contain of complex problems, establish a most wholesome standard for English writing. In this particular they seem to the reviewer to mark a distinct advance upon their forerunners, the volumes on qualitative investigations. The typographical work has also been well done, although errors are by no means wanting.

The first question of general significance raised by these treatises concerns the soundness and expediency of the division of the experimental field into a qualitative and a quantitative portion. The reviewer commented upon this matter in a notice of the earlier volumes, but it merits a further word in the light of the volumes now before us which reveal in complete form the author's conception of the distinction.

As the reviewer understands him Professor Titchener maintains that a knowledge of the quantitative relations of mental processes is as much a fundamental part of psychology as the knowledge of their qualitative peculiarities. The manuals themselves furnish the best evidence that from the practical point of view the division is not only feasible but also pedagogically useful and scientifically warranted. It enables one to present the field of experimental psychology with due regard to those lines of cleavage which have been historically significant and it reflects a distinction in methodological procedure that fully justifies recognition in some form as radical as this embodied in the author's devotion of separate volumes to its exposition.

If the isolation from one another of the quantitative and the qualitative experiments has any practical drawbacks, it is more likely that these will be found to inhere in the conveyance of exaggerated impressions of the ultimacy of the division and the exhaustiveness of the two branches of psychological inquiry. The two provinces are integral portions of the general psychological realm, however disparate their methods and aims may be. Moreover, there are other methods and points of view, *e.g.*, the genetic, which are equally valid and thoroughly promising. Of course considerations of this kind have weight only in connection with the more or less unconscious influences exercised by a text over the minds of young students. No one would think of accusing Professor Titchener himself of lack of breadth in his conception of the legitimate psychological methods.

On the theoretical side, the division raises a question of scientific classification which is intrinsically interesting and of peculiar import in this immediate instance because the reply given by our author [as will presently appear] is in reality based upon the most fundamental prepossession in his treatise, *i. e.*, the nature of mental measurement.

In our general works on psychology there is often no substantial distinction made between psychophysics and quantitative psychology. Nor is this strange when one remembers that until recently most of the English writing on matters pertaining to this range of problems was done under the controling influence of Fechner for whom the dominant interests were psychophysical in the precise meaning of the term. From the point of view of our author, however, the distinction is at once real and pregnant. Psychophysics is but one chapter in a quantitative psychology. Strictly considered, the fundamental interest in psychophysics proper is always centered in the discovery of the quantitative relations between consciousness and the physical world, whether the latter is represented by processes in the animal body, or by the extra-organic molecular movements constituting a physiological stimulus. As distinguished from this conception of psychophysics quantitative psychology finds its problem in analyzing the quantita-

tive aspects of mental processes *per se* and quite apart from any overt reference to the physical world. It must be admitted that in actual practice the difference between the two forms of inquiry often dwindles to the vanishing point. But this does not invalidate the fact that the ultimate aims of the two are distinct. Moreover, in many cases the procedure is different. But however tenable this line of demarcation, if accepted, it instantly raises the question of the status of psychophysics in psychology. Does psychophysics fall definitely inside the range of psychology?

Whether psychophysics is to be accepted frankly into the family as a genuine member of the psychological flock obviously depends altogether upon one's conception of the scope of psychology. It is quite possible to view psychology in such a way as to render psychophysics at best a hermaphrodite form with a dubious position. For example, if one considers the proper business of psychology to be the analysis of consciousness conceived in common-sense severance from the world of physics, it would seem to follow that psychophysics as an end in itself must fall somewhat outside the barriers, or at all events must sustain to the main stream of psychological interest a purely ancillary relation. If one, on the other hand, accords to the jurisdiction of psychology anything which comes to hand in the search after knowledge about the mind, it is entirely possible to welcome psychophysics as an orthodox member of the fold. The definitions of most contemporary psychologists probably look toward the first conception, but their practice quite as certainly looks in the other direction. At least the reviewer recalls no psychologist who does not gladly invade any territory contiguous to his own when the raid promises booty of a valuable kind. This is illustrated constantly and somewhat flagrantly by the familiar citations of materials gained from neurology which can hardly by any stretch of the imagination be regarded as properly psychological ground, when one limits this ground to the immediate analysis of consciousness as such.

On the most fundamental and significant problem of the quantitative psychology, *i. e.*, the possibility of, and the nature of, mental measurement, the author is frankly a disciple of Delbœuf. The material of mental measurement is not sensation as such but (in the range of sensory processes, of which alone we shall speak here) sense distances, contrasts or relations between sense excitations. This view at once forestalls a basal weakness in the original Fechnerian position against which armies of critics have directed their fire. It avoids the necessity for defending sensation as itself a measurable magnitude. Indeed, it goes further and maintains, as do certain mathematicians, that such an isolated quantity as would be afforded by a sensation possessing magnitude of and by itself is absurd and impossible. Meantime it vigorously champions the measurable and quantitative nature of the sense distances.

The other half of the fundamental perplexity confronting a quantitative psychology [for the first point to which we have just referred is but a part of a larger whole], concerns the determination of a unit of measurement. This also is solved on Delbœufean lines by resort to increments of sense distances which prove in actual practice to be highly similar to the Fechnerian increments of sensation, although the conception of them is different in theory and their place in a psychophysics is different from that accorded by Fechner to his increments. Sensation is not itself regarded as constituted by integrated increments, but the sense distances are measurable in terms of noticeable incremental differences. The unit is arbitrary but justifiable because practicable.

Evidently the utility of such a unit will depend upon its equality over the whole range of sense excitation to which it may be desirable to apply measurement. This fact calls to mind the old familiar contest which Fechner carried on with his adversaries. He stoutly maintained that the increments were equal in different parts of the sense scale. Many of his critics have insisted that this contention flies directly in the face of the most obvious introspection, and to the rank and file of non-psychophysical psychologists their position has generally seemed valid. They urge as an insuperable difficulty the alleged fact that in the field of pressure sensations, for example, the just noticeable difference which enables us to discriminate a gram from some other heavier weight does not seem to us at all the same as the j. n. d., which permits us to distinguish between a weight of a hundred pounds and another proportionately heavier. On this issue Professor Titchener is a rather guarded upholder of the equality of the increments of sense distance throughout the intensive scale. His attitude is determined in part (so far as concerns the supraliminal distances) by his own introspective deliverances, and in part by the fact that the results of measurements made on the assumption that the increments are practically equal apparently substantiate the claim. At all events they do not militate against it. The reviewer cannot refrain from remarking that with regard to difficulties of the kind here involved a functional psychology occupies a peculiarly strategic position. A structural psychology may well be in doubt about the equality of the these j. n. d. increments. Functionally they are unquestionably equal and this would appear to be the point of really fundamental moment.

It has probably been evident that everything which has been said up to this point has direct and immediate bearing on the intensity relations of psychic processes. But the circumstances which attach to the quantitative relations of a spatial and temporal kind and to the serial arrangements of a qualitative sort are not sufficiently different in nature to necessitate a separate treatment at this juncture.

A large part of the discussion about mental measurement has been pertinent primarily to the theoretical rather than to the practical interests involved. Nor is the cogency of the outcome particularly flattering to the lucidity of the protagonists. Indeed, much of the controversial writing suggests souls calling to one another across oceans of misunderstanding, and unhappily the calls are not always agreeably toned at that. Professor Titchener's citations exhibit strikingly the extent to which utterly divergent and ultra-respectable scientific opinion may be cherished on the theoretical questions at stake. By something of a *tour de force* he manages to discover strains of agreement in a number of the important authorities, but the achievement has impressed the reviewer as the worthy effort of a peacemaker and a searcher for harmony, rather than as the disinterested registration of an obvious fact.

But whether one adopts the general views of Delbœuf, or of Wundt or Müller, or even of Fechner, there are many points in one's practical procedure which might remain substantially unaltered. For example, one might employ the method of minimal change without essential modification, whether one were primarily engaged in determining a limen in the sense of Fechner, or a serial determination of intensive sense distances in Delbœuf's sense. Of all of which the point is that one must distinguish sharply between questions of technique in procedure and questions of theory as regards the status of quantified method in psychology. The two issues are of course vitally related from the standpoint of any ultimate view, but an agreement on prac-

tical procedure is as compatible with divergent beliefs about the theoretical matters involved, as is agreement about physical measuring with discrepant notions of the nature of matter. On the question of practical procedure, there is already extensive agreement and doubtless will speedily be more as the real basis of the differences of opinion becomes clarified. On the underlying problems of a theoretical character the decadence of controversy will probably be much slower, but fortunately it is practically much less important.

It would be pretentious to attempt an exhaustive critique of Delbœuf's view of the subject of mental measurement, but a mere word of commentary may be permitted. Passing over such refinements of criticism as Meinong's (not as valueless, but as momentarily irrelevant), and disregarding the advocates of mental mensuration as primarily applicable to processes of judgment and apperception (for whose views there is much to be said), it appears that the position of Delbœuf, while superior to its predecessors as a practical working foundation. has not altogether escaped certain of the limitations which hedged them about. Two of these may be mentioned.

In the first place, however strenuously it may be urged that these Delbœufean measurements are mental aud not physical measurements, it still remains true that all expressions of them, all tangible results of them must be formulated with the assistance of physical terms. This is perhaps nothing to their discredit as compared with physical measurements, which require not only physical units, but also an observing mind to make the measurements. The two are at quits on this score. But the facts warrant notice whenever emphasis is being put upon the *purely* mental character of the Delbœufean measurements. Physical stimuli are constantly in evidence whenever specific quantitative terms are desired. Nor do we forget in making this assertion that these stimuli are employed as means and never as ends in themselves. But pure mental quantification is apparently an invertebrate form which requires the stiffening of some kind of physical spine in order to render it practically available.

In the second place, the sense distance which is the measurable magnitude under this theory, psychologically considered, is something of an artifact, as were the Fechnerian increments of sensation. This does not prevent its successful employment for the purpose in hand (nor were the increments of Fechner intrinsically impractical), but it does in a degree affect its status as a psychological term. To illustrate, when one light is sensed as brighter than another just preceding, it does not seem to correspond to anything commonly experienced when the second light is apprehended, to say that the distance of the one from the other on an intensive scale is thereby established; nor is the situation altered by any such considerations as those set forth in Professor James' description (closely resembling in its immanent psychology certain of Fechner's conceptions) of the second sensation as being a sensation of light-B-brighter-than-light-A. It is felt as brighter without doubt, but in this awareness of superior brightness there is no necessary consciousness of the distance between the two as sense distance. That is to say, the immediate conscious reaction is "brighter," but the quantitative ranging of the experiences on an intensive scale, which is in some form or other essential to measurement, is a sophisticated afterthought of the professional psychologist. To read it in as a regular feature of intensive comparisons is to commit the psychologist's fallacy in a peculiarly obvious way.

To this line of attack Professor Titchener has already prepared a reply which relies for its force upon the contention that we often make quantitative judgments without being conscious of the quantity as

quantity. The reviewer does not challenge this assertion but he raises the previous question and remarks that whereas the Fechnerian conception of mental measurement has frequently been characterized as in reality physical measurement, the Delbœufean conception in its turn offers a somewhat vicarious type of measurement, inasmuch as the serial arrangement indispensable to the real measuring process is often not overtly present at all to the consciousness upon which the measurements are being executed. These comments are offered in no spirit of hostile criticism, for the reviewer's attitude is distinctly sympathetic towards the Delbœufean view, but simply to emphasize the fact that there are residual difficulties, or at least limitations, for this theory as well as for its forerunners.

On one rather important matter closely related to the preceding topic, Professor Titchener seems to have fallen into a curious inconsistency. He says (Student's Manual, p. vi) that the question asked of consciousness in quantitative experiments is never the direct question 'how much,' but *always* one or other of the two questions 'present or absent' or 'same or different.' But on page 56 of the same book in describing the procedure for a test on the DL for brightness he speaks of the O saying at a certain point 'lighter.' And again on page 106 in giving directions for tests on the DL for pressure he says the "judgments may take the form 'much greater,' 'greater,' " etc. Now the reviewer has no desire to invest time in assaulting a man of straw and the author probably has some ready explanation for this seeming contradiction in his utterances. But whatever the facts as regards this part of the question, it appears to be reasonably evident that only on the basis of the ability of consciousness to give judgments of the "greater" or "less" type does it become possible to speak of conscious processes as being properly subject to arrangement in a quantitative series. It is perhaps possible so to devise one's experiments that the verbal reaction shall always be either "present or absent" or "same or different." But the actual conscious reaction either involves directly the quantitative predicate, implicitly if not on every occasion overtly, or consciousness is not susceptible to genuinely quantitative treatment. Even if one attempts so to arrange one's procedure that the question "how much" is never directly asked, there are certain experiments, *e.g.*, those on equality of spatial distances, in which this query insists on impinging upon the consciousness of the O, however scrupulously the E has endeavored to avoid it.

Before examining the detailed arrangement of his work we may note that Professor Titchener does all he can to aid in the worthy effort to put Weber's law in the subordinate position which it really deserves to occupy. German psychologists have for a long time ascribed to it a position of secondary importance, but in the writings of English and American psychologists it has persisted in monopolizing the foreground as constituting substantially the alpha and omega of accomplishment in quantitative psychology. To be sure this attitude is often varied by recognition that its demonstrated validity is limited to certain ranges of sense experience and valid therein only on terms of sufferance for irregularities. But even so it looms large. To the reviewer this fact seems attributable without serious doubt to the philosophical and cosmological interpretations accorded it. In any event we appear to be entering upon a period of larger enlightenment concerning the merits of the case.

Turning to the organization of the books we find that the volumes fall into three principal chapters of which the first is entitled "Preliminary Experiments" and consists of illustrative determinations of qualitative and intensive limens. The second is devoted to the metric

methods and contains experiments illustrative of all the more important forms of quantitative procedure in the realm of sensation, and the third is given over to reaction experiments from the quantitative point of view, including a rather extensive expository account of electrical units and methods. A final and much briefer chapter discusses the psychology of time from the same standpoint. In addition to these divisions, the Instructor's Manual has an elaborate and invaluable introductory account of the rise and progress of quantitative psychology, which constitutes essentially a critical history of psychophysics, and this finds a much briefer counterpart in an introductory section in the Student's Manual describing the field of measurement in general and psychological measurements in particular. The Instructor's Manual has also a chapter on typical experiments in quantitative psychology and three appendices dedicated to examinations, books, instruments and dealers in them. Indices of various kinds complete the useful machinery with which the volumes are provided.

The amount of space reserved for discussion and explanation of electrical apparatus and electrical principles will no doubt appear to certain instructors excessive, while others will feel that the space devoted to purely mathematical exposition is unnecessarily extended. But the author has the comfort of knowing that no course which could be selected would please every one on this score. Meantime in the reviewer's opinion the plan pursued is altogether judicious and profitable. The unfathomed ignorance of the average student concerning the facts in the case passes belief unless one has for some years given instruction to classes in laboratoty psychology.

So far as the reviewer has any quarrel with the portions of the text which deal with apparatus his criticism would be directed at the failure to characterize certain pieces as frankly as his own experience would warrant. The difficulties are no doubt often the fault of the mechanic and not defects in the theory of construction. But the results for the unsophisticated purchaser are one and the same. Thus, for instance, the Zeitsinn apparatus pictured on page 399 of the I. M. is by no means always so constructed as to permit satisfactory results. Nor does the author's reason for introducing Scripture's touch weights (S. M. p. 15.) seem convincing. He admits in a comment in the I. M. that the apparatus is unsatisfactory. The reviewer has encountered many sets of these weights and while he is certain that occasional sets must have been so constructed as to give reliable results, he is eqnally certain that the average set converts the experiment into a farce. So, too, the cartridge weights mentioned for experiments on pressure on page 189 of the I. M. have the advantage of cheapness and the endorsement of wide use, but they almost invariably wobble if used for any of the higher weights, *e. g.*, 100 grams, and they commonly require a pad to minimize temperature effects. This pad seldom transmits the pressure equally over the various parts of its surface. The same kind of limitation holds true of other pieces of listed material. Criticism of this sort would be sheer carping were not the author's dictum on these subjects so often taken uncritically as gospel, In consequence, a higher degree of responsibility rests on him than falls to the lot of most of us.

On one matter of practical importance to students *i. e.* the subjective criterion of assurance, the writer could wish that the author had given more specific instructions and advice. The difference between doubt and assurance is nowhere more strikingly brought out and nowhere in the realm of psychological studies more significant than in the case of quantitative experiments. Shall one, for example, establishas his standard for judging that two sensations are intensively

different a conviction altogether unalterable, or shall one employ an attitude of practical assurance similar to that with which one accepts as true the recollection of one's whereabouts a week ago, or, finally, shall one cultivate a more highly sensitive appreciation and give a positive judgment whenever one suspects a balance in favor of a difference? Any one of these attitudes may give relatively consistent results if adopted and conscientiously carried through. But there is of course a choice and there may be other attitudes still more judicious.

In the writer's experience the personal equation comes in here in a very disturbing manner and students are nonplussed and often discouraged, if not disgusted, to find that several of them have been proceeding in diverse ways when supposedly using similar methods. Moreover, the difficulty is likely to obtrude itself on the student's attention despite every precaution on the part of the instructor. Of course every teacher gives his own students directions upon this familiar difficulty of quantitative work, but a fuller discussion than has been offered by Professor Titchener would have been most welcome and of the greatest value in its tendency toward uniformity of understanding if not of procedure. Apart from the purely psychological issue involved, the point really raises the whole question of the nature of certain of the measurements and the part played by errors of observation.

On the important matters relating to the specific psychophysic methods the author has obviously been much influenced by Professor G. E. Müller. These questions are taken up in the second main part of the texts. In the S. M. attention is chiefly confined to directions for the application of the technique. The I. M., as was noticed above, offers a most valuable historical and critical exegesis. The methods are discussed under the following headings: (a) the method of limits in its various forms (at present commonly designated in English as the method of minimal change); (b) the method of average error with its subordinate form the method of equivalents; (c) the method of equal sense distances generally known in connection with its several modes as the 'gradation methods;' and (d) the method of constant stimulus and constant stimulus differences, historically familiar as the method of right and wrong cases.

To readers accustomed to the older nomenclature the terms used to designate the different methods seem somewhat strange and possibly a trifle cumbrous. But on the whole (with one possible exception, *i. e.* certain of the forms of minimal change) they are intrinsically distinct improvements upon those commonly in vogue, for they suggest more immediately and less ambiguously than do these the essential characteristics of each.

As is well known, the proposed classification of the methods are almost as numerous as the psychophysical investigators. From the student's point of view, the main consideration is that the classification offered shall display the relations most essential for both theory and practice in an intelligible manner, and this result is accomplished successfully by the arrangement adopted by our author. It possibly tends, however, to emphasize differences at the cost of obscuring similarities, and the reviewer is strongly of the opinion that a more overt and explicit discussion than occurs anywhere in the text justifying the usage employed would have been a great boon to students and a material addition to the value of the treatises. The author's labors peculiarly fit him to handle with lucidity and relative ease the complex problems and relations involved.

As compared with Professor Titchener's previous books, the pres-

ent volumes suggest a higher nervous tension in composition. He has evidently welcomed the opportunity to free his mind on a number of subjects in which his emotions are somewhat concerned. The criticisms are often sharp to the point of the caustic and more personally toned than heretofore. This tendency, suggestive of the fruits of long contact with German usages and particularly with Professor G. E. Müller, that acrimonious guardian of the psychological fold, the reviewer regards with chastened enthusiasm. To be sure the technical tedium of the text is considerably relieved by these excursus, but the books were not written primarily for entertainment. For the most part, be it said, the criticism is perfectly objective, as scientific criticism seemingly should be. Moreover, the author sins as little in this way as any psychologist known to the writer.

In conclusion the reviewer is moved to express a measure of dissent from Professor Titchener's estimate of the importance of the spread of interest and proficiency in quantitative psychology. The difference is perhaps largely one of degree of emphasis. To the writer it does not seem probable that the extended development of quantitative investigations is an immediate *sine qua non* of further progress in psychology. So far as these methods invite and stimulate exactness and accuracy and appreciation of scholarly modes of work, so far will a wide-spread familiarity with them in psychological circles be rewarded by an increase in the amount and scientific character of the output of our investigators. The reviewer has always felt the most unreserved confidence in the improvement which would accrue to the qualitative studies from a more thorough acquaintance with the quantitative procedures. As every experimentalist knows, there is hardly a problem in qualitative psychology in which some trace of the quantitative element is not to be found, and in practically all experiments, a regard for the canons of such procedure is indispensable to trustworthy results. For their general tonic effects, therefore, as well as for their practical utility in qualitative research, the reviewer looks with great hopefulness upon the development of interest in quantitative methods and problems. Nor would the reviewer be understood as depreciating the value of quantitative work on its own merits and for its intrinsic worth. Quite the contrary. But as the writer understands him, Professor Titchener would take a more extreme and positive attitude, with the conviction that we have gone about as far as we safely can without assistance from the quantitative side. The reviewer feels that there is yet much useful pioneer work to be done before the nicety of the quantitative methods can be summoned to trim up the edges. All this is matter of opinion pure and simple and time alone will determine the more correct estimate. For better or for worse there can be no question that these volumes will instigate a large amount of intelligent interest where before there was nothing but ignorance and hearsay. And no doubt, too, out of this new-born interest will blossom much research of a high order. For all this and for much more Professor Titchener will have our gratitude and appreciation.

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L'Attention, by W. B. PILLSBURY. Bibliotheque internationale de psychologie expérimentale. Octave Doin, Paris, 1906. pp. 299.

Professor Pillsbury and his pupils at the University of Michigan, have for some time been devoting experimental study to the so-called fluctuations of attention. The present book, however, refers only in passing to this work; it is a general treatise undertaking to summarize the facts about attention and to include them under a theory. The facts are grouped in the first eight chapters, entitled 'The

Psychic Effects of Attention;' 'The Motor Phenomena Accompanying Attention;' 'The Conditions of Attention;' 'Interest and the Feeling of Activity;' 'The Effects of Attention on Consciousness;' 'Attention and Ideas;' 'Attention and Association in Perception;' 'Attention in Memory.' The essence of attention as a mental phenomenon is declared to be increased clearness, and increased intensity is held under certain conditions also to occur. The motor phenomena of attention often follow attention proper, hence do not constitute it. To explain the fluctuations of attention, fatigue of the cortical cells, both those involved in the sensations attended to and those corresponding to associated ideas (the Lange memory-image theory) is invoked, but the length of the attention wave is supposed to be determined by vaso-motor and respiratory rhythms. The latter by themselves would not explain cases of rivalry, where processes in two sets of cortical centres are alternately dominant. The former alone would not explain the rhythmic regularity of the changes. Dr. Pillsbury's idea, as explained on p. 101, apparently is that in rivalry, at the moment of the general depression produced by the trough of a vaso-motor wave the unfatigued set of cells has an advantage over the fatigued set and a chance to assume dominance.

Under the head of 'Conditions of Attention,' the writer emphasizes the distinction between objective and subjective conditions. The former comprise the intensity, extent and duration of the stimulus; the latter, the contents of consciousness at the moment of attention, and farther back, the education, social surroundings and heredity of the individual. The distinction is not clearly drawn, however; for instance, movement is placed in the subjective class because its efficiency in directing attention depends on the biological conditions of mental development, while change in the intensity of a stimulus is referred to the objective class. Surely both are subjective if dependence on evolutionary conditions is the test of subjectivity, and both objective if that term designates characteristics belonging to the stimulus itself. One of the conclusions of the chapter on 'Attention and Ideas,' is that "every centrally excited process . . . is the result of two series of conditions, objective-associational and subjective-attentional." Thus the suggestion is clearly made that the essential conditions of attention are the subjective ones. We shall return to this point later.

Professor Pillsbury's discussion of theories of attention is clear and valuable. He divides them into three groups: those which relate attention to apperception, those which like the motor theory of Ribot elevate some accompanying phenomenon to the rank of an essential feature, and those which are purely physiological in their character. In discussing Wundt's apperception theory, the author makes the statement that Münsterberg has in the last ten years completely changed his position: while he formerly objected to explaining anything in consciousness by an unknown element outside of consciousness, "he now maintains that all consciousness is simply the manifestation of an unknown will." This position Dr. Pillsbury declares to be the counterpart of Wundt's apperception doctrine (p. 182). Münsterberg is clearly misrepresented here; he does not use his 'unknown will' to explain anything in consciousness. It remains forever removed from the world of science where explanations hold sway, and the only possibility of explaining conscious processes lies for him on the physiological side. It is perhaps connected with this misapprehension that Münsterberg's central physiological theory is nowhere mentioned in the book.

The chapter on 'The Physiology of Attention' contains the ablest

and most original part of Dr. Pillsbury's work. In the preceding chapter he accepts the evidence put forth in behalf of the frontal lobes as the anatomical substrate of attention. He now points out that various experimental data, for instance, the results of Bowditch, Lombard and Warren on the knee-jerk, indicate that one nerve centre may affect another by way of inhibition and reinforcement. The work of Bruce on retinal rivalry and that of Taylor on the fluctuations of the Masson gray ring as affected by additional stimuli, may be interpreted as showing that such inhibition and reinforcement operate in the field of attention. The experiments of Lange on the effect of associated ideas in holding before the attention one interpretation of an ambiguous figure such as the outline cube, indicate that the centres chiefly active in such reinforcement and inhibition are those especially associated with the centres affected. Dr. Pillsbury prefers to allow the possibility of both reinforcement and inhibition, rather than to depend solely upon inhibition, after the Wundtian fashion, because he thinks there is evidence for positive effects of attention, such as increase in the intensity of a sensation. Attention, then, is explained physiologically as the result of the reinforcing action of certain cortical cells upon other associated cortical cells, plus a probable inhibitory effect of the former upon the rest of the cortex. What distinguishes it from association? This primarily: that it is an effect of one group of cells upon another, produced through the medium of the frontal lobes, while association may take place, as Flechsig supposes, directly between the various sensory regions of the cortex. The objective factors in association depend probably upon such direct connection; the subjective factors, involving the individual's whole past and heredity, must depend upon an organization of the entire cortex through the frontal lobes. There are three principal differences between that action of one group of cells upon another which is involved in attention and that which is involved in association. First, in the former case, such action is not the sole or principal factor exciting the affected group, as it is in the latter case; second, in attention the process in the cells which exercise the modifying influence need not be accompanied by consciousness, while it ordinarily is so accompanied in association; third, the effect in attention is produced by a general participation of the whole cortex, while in association only a localized group of cells is active.

Space forbids a discussion of the interesting applications which Professor Pillsbury makes of his theory to pathological phenomena. It is perhaps most valuable in its definition of the relations between attention and association. The working out of the psychological aspect of the author's theory in the earlier chapters seems, however, less clearly conceived than that of its physiological basis. If objective relations between conscious processes depend physiologically upon mere associative connections between sensory centres, while only the subjective factors involve the reaction of the whole cortex through the frontal lobes, why should we have objective and subjective conditions of attention distinguished, and imperfectly distinguished at that, as we have seen in the earlier chapters? As a matter of fact there are no purely objective conditions of attention. Mere intensity, for example, does not condition attention. When I ride in a trolley through a crowded city street, my eyes are dazzled and my ears deafened by intense stimuli which may pass almost wholly unnoticed as I occupy myself with a train of thought. Sudden increase in intensity does attract attention, because it appeals to an instinct based far back in the part of the species, and is therefore classed among the subjective conditions of attention. We attend to nothing save through

the reaction of the whole cortex, hence we attend to nothing for really objective reasons.

A word or two is necessary in regard to the translation. It is unfortunate that we should not have had this scholarly and suggestive book in its native English, for the French version is not always clear and is occasionally incorrect. To mention only two examples of the latter fact, when Dr. Pillsbury speaks of 'the mood of the moment' as among the subjective conditions of attention, 'le mode du moment' is meaningless as a translation. When he refers to "Stout's 'tendency towards an end,' " meaning the principle thus designated by Stout, there is an ominous suggestion in the translators' 'la tendance de Stout vers une fin'!

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PSYCHIATRICAL LITERATURE.

By ISADOR H. CORIAT, M. D.

Les Écrits et Les Dessins dans les Maladies Nerveuses et Mentales par J. ROQUES DE FURSAC. Masson et Cie., Paris, 1905. pp. 306.

The value of speech and writing as a diagnostic adjunct to the study of neurology and psychiatry, has been emphasized during the last year by the monographs of Köster and Liebmann, the former relating to graphological disorders without any effort at discussion, the latter to stenographic samples of special disturbances of language. Roques de Fursac, however, has given us a comprehensive and readable treatise on this important subject, although he enters into dogmatic and, at times, tedious discussions. According to him the clinical description of the disorders of writing comprises two points: first, in the material execution of the writing, in its totality, direction and form of lines and the form and dimensions of the letters; secondly, the content of the writing, or the ideas expressed or reproduced by the writer. The study of the first is called caligraphy, of the second psychography. All psychic symptoms, excitements, depression, intellectual enfeeblement, modify the characteristics of the handwriting. The elementary caligraphic disorders relate to the direction and form of the lines, and the direction, dimensions and form of the letters. There is postulated the existence of a special graphomotor centre in the second left frontal convolution, disturbances in this centre giving rise to agraphia and paragraphia. Other symptoms that may arise in various nervous and mental disorders are omission, impossibility of copying, false syntax, substitutions, transpositions, additions, graphic incoherence, echographia, and graphic stereotypy and impulsions. The illustrations are excellent and include samples of writing in paralysis agitans, exophthalmic goitre, chorea, tabes, multiple sclerosis, writer's cramp, the various stages of epilepsy and general paralysis, organic dementia, dementia præcox, acute and chronic alcoholism, various confusional and delirious states, manic-depressive insanity, melancholia, neurasthenia, hysteria, idiocy, imbecility and paranoic states. Especially well shown is the tremor of delirium tremens. One important symptom of katatonia, namely the capitalization of the first letter of each word, seems to have been unobserved by the author. The drawings are very elaborate productions and mostly of the mystic, paranoic type.

Contribution à l'étude de l'Écriture en miroir, par A. LAPRADE. Ollier, Paris, 1905. pp. 58.

If, as has been claimed, mirror writing is the normal chirography of left-handed persons, the subject is closely allied to the dual functions of the brain. The most famous mirror writer in history was Leonardo da Vinci, but this was acquired, as, according to De Beatis, he suffered from paralysis of the right arm. Mirror writing is frequently found in idiots and imbeciles with right hemiplegia or monoplegia and it is not uncommon among left-handed school children. It has been pointed out, that if right-handed persons be asked to write with the left hand with closed eyes, the writing is normal and from left to right and not of the mirror type, thus showing that our memories of letters are visual and not motor. In that writing which goes normally from right to left, as in Hebrew and modern Arabic, the letters seem naturally adapted for this direction. Laprade, in a short monograph, has renewed this interesting question and given abstracts of all the published cases, together with a personal observation, and there is appended a complete bibliography. Pathologically, mirror writing is found to occur in hemiplegia with focal disturbances of reading, writing, and speech, melancholia, hysteria and imbecility. In a case of mirror writing in an imbecile, the patient learned to write before learning to read, and there was, therefore, no means of correcting the error. In the writer's case, in a right-handed man who developed mirror writing following the forced disuse of the right hand as a consequence of a hemiplegia, there was found at autopsy a lesion of the anterior two-thirds and knee of the internal capsule with degeneration of the pyramidal tract and of the facial and hypoglossal bundles. Of course this has no genetic bearing upon the clinical findings.

A Text Book of Psychiatry, by LEONARDO BIANCHI. Authorized translation from the Italian by James H. McDonald. Balliere, Tindall and Cox, London, 1906. pp. xv+904.

Professor Bianchi's "Trattato di Psichiatria" represents the high water mark of Italian psychiatry. It will be welcomed in its English dress if for no other reason than that its system of classification represents a protest against the mental epidemic of Kraepelinism that is sweeping over America. Asylum physicians have bolted Kraepelin whole, without that mental digestion which is the result of independent thinking, and as a result they attempt to force every form of mental disease into Kraepelin's classification. It is unfortunate that Wernicke remains so little known, believing as he does, that in the present state of our knowledge of psychiatry, we are warranted in making only a symptomalogical diagnosis, and that we possess but few clinical entities, *e. g.*, general paralysis, the febrile and toxic psychosis, and the insanities of defective development.

The fundamental principles of the tendencies of various classifications in psychiatry is of interest. The older alienists based their classification on the emotional tone of the patient, and thus arose the much abused terms of mania and melancholia; Kraepelin bases his work on the prognosis of the disease process alone; Wernicke, on a hypothetical cerebral localization; Ziehen, on an association psychology; Bianchi on purely etiological considerations. Personal factors, studies in organic brain affections, pathological anatomy, experiments with drugs in producing artificial mental states, association measured with instruments of precision, have all, in the training of the various exponents of psychiatrical classification, been the contributing factors from which latter evolved each individual system of psychiatry. The ideal can only be arrived at by a harmonious blend-

ing of all these criteria, a point not yet reached by any of the various systems proposed. But after all, mere classification is not the complete word or the final salvation; the minute analysis of all clinical symptoms should be the effort of every worker in psychiatry, for at present, psychiatry is in the old position of internal medicine before the advent of an accurate pathological anatomy, when many acute diseases were grouped under the generic name of "fevers," because of an accompanying elevation of temperature. The analysis of clinical symptoms alone will solve the perplexing problem of mental disorders, and then perhaps a final classification will arise, if such be the end desired, that will stand the test and onslaught of the various clinical manifestations.

Bianchi's book is divided into two portions: the first comprises the gross and minute anatomy of the brain, together with certain psychopathological considerations, the second deals with the special forms of mental disease. The raison d'être for the first part, is well stated in the preface. "To-day, in Italy, which has so largely contributed to the progress of the physiology and histology of the nerve centres, we could not understand a book on psychiatry unless all the corollaries drawn from the various sources were utilized in the interpretation of the phenomena of psychic life. The physiology of the brain, on the solid foundations of morphology and histology, constitutes the heart and nutrient vessels of a medical work on psychiatry." Following along this line of argumentation, Bianchi gives a rapid but fairly minute review of the chief facts of brain anatomy and histology, together with the physiology of the central nervous system in general and of the mechanism of speech in particular. He then passes to an elaborate discussion of the physio-pathology of perception, attention, memory, ideation, emotions, sentiments, will and consciousness. One of the best chapters is that on the methods and field of clinical inquiry. Its scheme, though a little forced and artificial and therefore requiring individual adaption to so flexible a subject as mental disorders, is yet a welcome one, if we consider that the future of psychiatry depends more on minute clinical analysis than on pure pathological anatomy, as the latter has yielded little of value except in a few organic affections. This, in spite of the dogmatic assertion of Nissl, that all mental disorders are but the expression of physical lesions of the cortex, for this will not apply to such diseases as hysteria, the psychasthenias and dementia præcox. In fact, all anatomical findings in the latter disease are secondary, nothing has been detected which can be looked upon as a primary lesion. The method of Ferrari is used for the mental status and for the purely psychological methods, such as reaction time, measure of attention, association, emotions, and measure of voluntary muscular energy, he makes use of the various methods of laboratory technique. In the functional examination of the nervous system, he directs particular attention to the signs of degeneration, a tendency to be expected in Italy, the home of a scientific criminal anthropology. The classification is the most interesting portion of the book, being based as is claimed, on the greatest number of fundamental criteria, as nosological, etiological and anatoma-pathological. Purely etiological considerations, however, enter largely into a number of his descriptions. He divides mental affections in three groups; the *first* comprising those of evolutionary psycho-cerebral defect, the *second* those disorders of infective, auto-toxic and toxic origin developing in individuals regularly evolved, the *third* comprises those affections with a localized or diffuse organic substratum.

In the *first group* are placed the phrenasthenias, the paraphenias,

various types of delinquency, epileptic, and hysterical insanity, developmental paranoia, fixed ideas and obsessions, neurasthenia and the sexual psychopathies. The phrenasthenias comprise all those forms of defective mental evolution, such as idiocy, imbecility and cretinism, caused by evolutionary defects, diffuse or circumbscribed pathological processes or by particular forms of intoxication, especially athyreosis. Under paraphrenias are grouped those defects of cerebral evolution manifesting themselves in eccentricity, originality and extravagances.

Delinquency comprises congenital moral insanity and born, acquired, or impulsive delinquents. Under epileptic insanity, he carefully distinguishes those cortical motor explosions which take place without any distubance or consciousness. (the tics.) He believes the various types of developemental paronoia to be entities, but excludes the confusional or acute hallucinatory form which leads to amentia or dementia as well as the systematized deliria following melancholia or the acute psychopathies (constitutional paranoic states, melancholia going into a paranoiac condition, and the paranoiac forms of dementia præcox). Like Kraepelin he considers paranioa as a single, uniform disease, but takes no note of fundamental paranoiac states as postulated and carefully analyzed by Wernicke, neither does he go to the extreme differentiation of Ziehen, who describes ten forms of paranoia. In the chapter on fixed ideas and obsessions, the observations of the French school are closely followed, while under the sexual psychopathies, the trend in the main is that of Krafft-Ebing.

The *second group* comprises psychopathies arising in individuals with a normally evolved brain. This is divided into two *sub-groups* —the *first* being psychoses of infection and autointoxication—the *second* that of the toxic psychoses, the various forms of drug deliria. In the first sub-group he includes mania, lypemania, exalted-depressive insanity, circular and periodical insanity, sensory insanity, mental confusion, acute paranoia, late paranoia, neurasthenic, choreic and luetic insanity, and acute delirium. Why these diseases should be looked upon as having either an infectious or an auto-toxic etiology, is difficult to see, as recent metabolism experiments along these lines, especially the work of Folin and Coriat on general paralysis and the various phases of manic-depressive insanity have yielded nothing of value, or at least nothing which has any strictly etiological bearing. He believes in a pure mania and melancholia, without periodicity, or at least not included in the province of manic-depressive insanity. If there be the occurrence of a similar or opposite phase later, he is still disinclined to include the attack in this group. He admits, however, that pure mania is a comparatively rare disease. His exalted-depressive insanity includes all that group where both melancholia and mania occur, whatever their order. No mention is made of mixed conditions. This complete variance with the clinical entity of manic-depressive insanity, including the manic, depressed and mixed phases as conceived by Kraepelin, together with a disinclination to accept dementia præcox even in its narrowest sense, as will be pointed out latter, is one of the most prominent features of Bianchi's treatise. From the clinical standpoint, the concept of maniac-depressive insanity, completely unifying the old perplexing problems of mania and melancholia, is one of the triumphs of modern psychiatry, and Bianchi's ideas along these lines certainly transcend and contradict all clinical experience. The manic phase with its psychomotor exaltation and flight of ideas, the depressed phase with its psychomotor inhibition and dearth of ideas, the triumph of the concept of the mixed conditions, a peculiar mixture of both states, certainly forms a triad which has stood the test of clinical experience and rigid study,

which after all is the redeeming and consistent feature of any new symptom-group in psychiatry. This, together with involution melancholia and dementia præcox in its narrower sense, that is, not as a common dumping ground for all atypical clinical forms of adolescent insanity, are the three disease of the Kraepelin school, which we can afford to bolt whole. They have already undergone mental digestion by our German confréres. Under sensory insanity he includes amentia, acute dementia, dementia præcox, katatonia, stupor and mental confusion. He looks upon them as mere syndromes, as only a part of the morbid picture, claiming that their onset is always with sensory disturbances, hallucinations, or delirium. He does not believe in elevating this syndrome to a clinical dignity. It may be pertinently asked — why? If an onset with sensory disturbances is to be the determining factor of his "sensory insanity," why does he not include under the group the various febrile and toxic psychoses, or even the paranoic states, for these likewise frequently start with isolated hallucinations or illusions? If, as he claims in a previous portion of the book, he has adopted a classification based upon the greatest number of fundamental criteria, nosological, etiological and anatomo-pathological, why does he postulate a group merely upon the content of sensory disturbances in the onset? The contradiction is very manifest. The entire concept of sensory insanity appears to us to be strained and artificial, and totally contradicted by all clinical study in its broadest sense.

Acute paronia, in its delirious or hallucinatory form, is an acute paranoic state, a paranoic delirium frequently with a mystical content. The late paranoias are really the hypochondriacal paranoic states of involution or senility. In the description of choreic insanity, there is no mention of the grave forms of chorea insaniens occurring during pregnancy. Under the *toxic psychoses* of the second subgroup, he includes the mental disturbances of pellagra, alcohol, morphine, cocaine, chloral, lead and carbon monoxide. Alcoholic insanity is given a rather poor clinical description. No mention is made of the exalted or depressive hallucinoses and only a few lines are given to the polyneuritic mental disturbance (Korssakow's disease). Under Saturnine insanity, nothing is said about the lead deliria, or the acute or chronic lead encephalopathies.

Group 3, includes all those diseases which are the expression of known or demonstrable anatomo-pathological alterations of the brain. The descriptions under this group, paralytic dementia, luetic, senile, post-apoplectic, aphasic and traumatic dementia, and the dementia from tumors, scleroses and other organic diseases of the brain, are among the best in the book. The forty-one clinical observations are minute and painstaking, while the illustrations, especially the pathological, leave nothing to be desired.

Histological Studies on the Localization of Cerebral Function, by ALFRED W. CAMPBELL. University Press, Cambridge, 1905. pp. 360.

These new histological studies on the localization of cerebral function, are in many respects so revolutionary and illuminating, that a rather detailed summary of the work seems justified. The greater part of the research was communicated to the Royal Society of London in 1903, and a full publication was made possible by a grant from this same society. Histological studies of the nervous system can be pushed in three directions; by the study of the brain during development, in conditions of disease, and in the normal state. In this case, the normal human material consisted of three cerebral hemispheres examined for nerve cells and fibres, three for fibres only and two par-

tially examined for both. The ages of the individuals ranged from 19 to 48 years. The normal comparative material comprised chimpanzee and orang brains. The pathological material included two brains from cases of amyotrophic lateral sclerosis, seven cases of amputation of extremities, three of tabes, one of an old capsular lesion and two cases of old standing blindness. After some general historical considerations on cortical fibre arrangement and nerve cell lamination, he proceeds to the minute study of the structure and functions of various portions of the cortex. The motor cortex of both man and the anthropoid ape, is limited to the anterior central convolution, the posterior being a "silent" area. This is in harmony with the electrical stimulation experiments of Sherrington and Grunbaum, but in contradistinction to the work of other physiologists. Histologically the area corresponds approximately to the distribution of the giant cells of Betz, cells which alone seem to control volitional muscular movements. In cases of amytrophic lateral sclerosis, a disease limited to the motor neurones, these Betz cells are alone liable to destruction. In cases of amputation also, the changes are limited to the precentral gyrus and the annectant para-central lobule. The post-central gyrus is purely sensory in function, constituting the higher cortical terminus for the conveyance and appreciation of impressions relating to the complex tactile sense. In this area there are no true cells of Betz. It seems to correspond to the Monakow's cortical lemniscus. In a disease primarily of the sensory neurones, namely, tabes dorsalis, the cortical cell changes are absolutely limited to this region, and in those conditions where the common sensations suffer a disturbance (tactile, muscular, stereognostic, pain, temperature), the histological changes found in the brain are also confined to the post-central gyrus. Histologically he distinguishes between the visuo-sensory and visuo-psychic areas, the functions of which are sufficiently indicated by their names. Both are limited to the calcarine region, a conclusion derived from ablational experiments and clinico-pathological material (cortical or subcortical hemianopsia, distribution of macular field, psychic blindness, alexia, color blindness, optic aphasia). The area of the cortex for the reception of auditory stimuli covers the transverse temporal gyri and in the recorded cases of long standing total cortical deafness, this area was included in the destruction, together with neighboring parts like the insula, supramarginal gyrus and the opercular part of the ascending parietal convolution. Its histological structure is homologous with the visual area. In cases of pure word deafness, he was unable to detect any microscopic changes in the left angular gyrus, but in the literature relating to this condition, there was found atrophy of the temporal lobes. The auditory neuronic chain is very complex, comprising the end fibres from the organ of Corti, the cochlear nerve, the ventral and dorsal cochlear nuclei as the first link in the chain; the striae medullares, the corpus trapezoideum and the superior olivary bodies as the second link; the retrolentiform portion of the internal capsule, the corona radiata and the temporal cortex as the third link. In conditions where the sound-perceiving or the sound-discriminating sense is impaired, any of these links may be disturbed. The physiological centre for the sense of smell is confined to the limbic lobe, the lobus pyriformis and the cornu ammonis. Clinico-pathological data have only partially borne out this evidence, however, but comparative anatomy has shown that the parts detailed are the primary olfactory centres, in spite of the contradictions seen in anosmatic animals. His "parietal" area comprises the precuneus, the superior parietal gyrus and the anterior part of the supra-marginal gyrus. Its function seems to be that of

elaborating the complex impressions of the muscular and the stereognostic senses. The "intermediate pre-central" field is in front of the pre-central area proper and extends downwards to the orbital surface of the hemisphere. It includes the well known area of Broca, the centre for speech. He partially postulates a separate writing area in this field, as he found cell changes in a case of amputation of the right hand, thus agreeing with Bianchi's theory. One of its chief functions seems to be the control of high and low evolutionary movements, this being so well marked that he states the following "Law:" "in the intermediate pre-central cortex there is a sequential deposition of centres for the control of higher evolutionary movements, following the same order from above downwards as that observed in the precentral area proper." The frontal and prefrontal areas are electrically "silent;" they seem to be the seat of the high cerebral functions, making up the "psychical tone" of the individual. Removal or disease seems to disaggregate the personality, peculiar forms of mental disturbance and alterations of character occur, the "Witzelsucht" of the German writers. In cases of dementia, the greatest cerebral wasting occurs in this region, varying directly with the amount of mental defect. In other words, the higher psychic and association functions seem to be localized in this area; witness the atrophy in idiocy, imbecility, general paralysis and in some cases of dementia præcox. The data of comparative anatomy also bears out this hypothesis. The island of Reil is phylogenetically very old, it probably represents the gustatory centre and it has been found altered in cases of aphasia. The addendum comprises the comparative anatomy and physiology of the brains of the cat, dog and pig. The plates are well drawn and graphically represent the views of the writer on all the points discussed. In view of the thorough work, it is to be hoped that the author will apply his methods (complete studies of serial sections over entire areas) to the study of the basal ganglia, the deeper parts of the cortex and various nerve tracts. I. H. CORIAT.

The Analysis of Racial Descent in Animals, by T. H. MONTGOMERY Henry Holt & Co., New York, 1906. pp. 311.

The author discusses environmental modes of existence, hereditary and embryonic differentiation, relations of modes of reproduction and conjugation, life cycles and polymorphism of individuals, variation and mutation, transmutation of species, parellelism of ontogeny and phylogeny, morphological comparisons, relative values of morphological characters and criteria of racial advancement. Each vital phenomena he considers a step in the individual or racial change. If the morphologist regards structure as a visible stage of progress, there can be no conflict between him and the physiologist. If we knew what form meant we should interpret it into function. Interpretations of descent have hitherto been too morphological. They should include chemical and physical constitution and environment, and especially the relative value of characters implied, the criterion of which is the degree of conservatism, should never be lost sight of. We must assume monophyletic origin until the opposite is proven. We must anticipate intermediate connectants between species, must consider modifications due to stimulating changes in the environment, and deem hereditable substance not excluded from external influence. The individual does not recapitulate the development of the race, and no particular ontogenic stages are more ancestrally remnant than others, but all stages of ontogeny are equally cenogenetic and palin-

genetic. To become inherited, a modification must produce changes in the energy of the germ plasm. All comparisons between diverse mechanisms are inexact analogies, but in most phylogenetic research we must base upon these. The unit of comparison is the whole individual during its life history and not any selected stage of it. The author inclines very strongly to Hatschek's trochophore theory, viz., that the free larvæ of marine annelids show uniformity of structure and these are all modifications of one kind. The earlier the modifications appear the more apt they are to be inherited. If the free swimming larvæ were a repetition of an ancestral adult condition, why should it not be equally conserved in marine and fresh water life?

Die Ameise, von K. ESCHERICH. Vieweg & Sohn, Braunschweig, 1906. pp. 232.

The author has here gathered the main results of the studies of nearly half a century and presented them in a systematic, critical way with 68 illustrations. The one great family of formicidæ comprises over five thousand species, sub-species and varieties. There are 170 genera and 5 great sub-families. There are enormous variations. The distribution of ants is almost worldwide between the polar circles. Although their optimal habitat seems to be the tropics, they have sometimes transcended both the Antarctic and the Arctic circle. They have a very common trait of founding states or colonies and the sterile female is greatly in evidence in all the species. While ants are no miniature men, they are no mere reflex automata, but have the psychic qualities of memory, association, perception, utilization of individual sense experience, and thus power of individual plastic adaptation. The latter is most pronounced among the workers, less with the queens and is almost undeveloped in the males. This difference has a very marked reflection in the structure of the brain which differs very much, the gray matter being far more developed in the workers. Something is known of their phylogeny. They long antedated man. Our author thinks that the first ants were winged and that they very slowly lost this trait, but that some species have reverted to wings, remarkable as this is. He also assumes that polymorphism had a slow development and is largely tropogenic. Wasmann has shown that the appearance of pseudogyns has a casual relation with the presence of certain guests of ants. These lived with them first in the symphilia. They were first received, they grew up in the nests and last the ants cared for them. These later destroyed the eggs and larvæ of their hosts. When the first workers appeared, there was, of course, an important change in the habits of these ants. Another phyletic trait is the slow development of the *Pilzgarten*. The writer believes that we can trace pretty directly the development of every stage of this process. He also has something to suggest about the instinct of feigning death, but the most important phyletic contribution is the writer's theory of eight stages in the development of the colonies, illustrated by as many different species. In this way he accounts for slavery, domestication and the development of mixed colonies. He deems that his results are borne out by the experiments of mixing species. On the whole this must be called quite a masterly compend.

Die Mimik des Denkes. Von DE SANCTIS. Halle, 1906.

De Sanctis reminds us that the reflexes, pulse, respiration, the pupil, respond with exquisite sensitiveness to psychic states. Thought mimesis comprises first that of sensory attention and second more intellectual inner reflection. The apparatus chiefly involved is the seventh pair of facial nerves, the root of which arises between the

pons and the medulla. Whether a cortical or bulbar origin is manifold or simple, probably neither Mendel's view that it is bulbar nor that of Monakow or Wildebrand that it is central should be neglected. Usually both are synergetically associated. Where the mimicry is purely voluntary the impulse probably originates from the psychomotor cortex. In childhood and in old age or in agenesia this is not developed. Animals differentiate their mimetic movements far less than man and their mimesis of attention has less emotional reinforcement. The higher animals have no proper centre for attentive mimesis. It may be in the ears or in the mouth. Sometimes it is a general irradiation and the whole body is motionless or tense, but with animals as soon as the tension becomes great it takes on an emotional character and spreads to the whole body, showing that attention is but little developed and that intellectual activity is not canalized in paralyzed nerve excitability. In old age mimic innervation loses the power to express transient effects by sufficient complementary movements, but only expresses the fundamental results in grosser movements. Old men in thinking are hypomimetic in comparison with children. Art shows the same thing.

In adults, thought mimesis is well differentiated from that of emotion, and in those accustomed to think, this difference stands out yet more clearly. In a certain sense this mimesis of thought in adults has its own organ, viz., the attentive mimic centre in the upper half of the face. This is often unsymmetrical. Its intensity is usually weak in brain workers, especially in those who have to tense the eyes its vigor is greater; in those who cannot read it is less. A very common irradiation is the mouth, but the individual variations are very great as is the toning of the effective elements. Very often we find positive anomalies which are hard to explain. They may extend not only to the back but to the limbs, head and the whole body. The mimesis of the sensory and inner attention is chiefly optical. Even the other senses express themselves in the visual sphere.

The mimesis of concentrated differs very much from that of diffuse thought. In the former the gestures and attitudes arise in the periphery and converge to the centre, especially the eye, as in the meditative type. Often the lower half of the face is hypertonic. This rigidity often distinguishes meditation from sleep. The muscles of the forehead are closely drawn together. The different types may vary according to the object, the habits of the subject or the degree of concentration. Some concentrations have a happy and some a sad nuance. The Japanese gods meditate with a smile. Philosophic thought is more often sad. The mystic illumination and unification are rapt as the writer shows by many quotations. The eyes may be rolled toward heaven or fixed upon some indefinite distance, and very often there is a peaceful and heavenly expression.

In diffuse thought and abstraction the attention is centrifugal. In dreamery, reverie, art, Donders and Darwin both find vacant expressions in the eyes. The axes may diverge and are not fixed. Donders found actual divergence in some cases. The physiognomy is often that of enchantment and the expression is more often happy than sad. Sometimes it is not unlike that of sleeping children; so in ecstasy and hallucination. This is often connected with love and monoideism and Buddhism, with synderesis, or unified with the absolute or Nirvana. The expression may be hyperasthenic and the wishing and longing may reach a painful intensity. All ecstasy is immobile and involves suspense and silence. God, says Meister Eckhardt, created the world in order to rest in contemplation. The Italians love to contemplate the actual visual world.

There are, of course, many modifications by race, sex, custom, age, and especially disease. The mimesis of attention in the blind is more fugitive, partial and less energetic than in normal people, and the contraction is often limited to a single group of muscles. The facial movements of the blind when reading aloud by touch are usually motor accompaniments of the oral expression and are weaker when they do not read aloud and vanish in inner attention, *e.g.*, arithmetic. All blind persons, when attentive, are more or less motionless, at least in head and face. In many, spontaneous attention causes tension of the muscles in the back of the neck which become stiff. The difference between those born blind and those who become blind later is that in the former the contraction of the muscles of the forehead and the orbiculares palpebrarum in commando exercises is very difficult, and those of the superciliary muscles are impossible, but by those blinded late in life the isolated contraction of the frontalis and obiculares is still possible, though it be often weak and sometimes that of the superciliary muscles may be possible even by itself alone. In anger and pain, all blind persons contract their tension muscles, but less than do normal persons.

The intellectual expression of thought, then, by adults is chiefly in the mimic eye zone and in its three dermal muscles. The latter have manifold phylogenetic and ontogenetic functions besides the expression of thought, but the superciliary is most set apart for this latter purpose. Duchenne thought that the frontalis was for attention, the orbicularis and the superciliary muscles for reflection. Most essential are the superciliary muscles which are completely expressive, though not exclusively devoted to attention. They are developed in animals and children to protect from light and are tense in heat, short-sightedness, anger, sadness, etc. Thus the original purpose of the ciliary muscle is to protect the eye. The superciliary muscle, therefore, has three functions. Its highest may be alone and independent of the other functions and other muscles. It makes the vertical furrows on the forehead. Charles Bell thought animals lacked it. How could its pain function be transmuted into thought. Darwin connected it with the child's cry, frowning being its last trace. It narrows and sharpens the field of vision according to his principle of the association of purposive habits. This resembles Wundt's or Piederit's association of analogous adjustment of sensations. "The muscular movements of expression relate to imaginary sense expressions." Thinking always causes effort, if not pain. It is the expression of the psychic. Thus the pessimist has some basis, if thought is pain. Thus to adjust the eye to light in the child is the basis of thought expression in the adult. Sensorial optical attention is its genetic foreschool. Some psychologists think attention is always moving; others that it is fixed, but both theories are needed. In even the best of us, attention and thought are not entirely free from emotion. Thus movement and inhibition act and react upon each other, but while there must be tension there must also be rest and silence. In thought, respiration and vasomotor activities diminish; the muscles are a little relaxed; the pupils widen; blood pressure changes. In general, mental work is thus very different from physical.

Physiology of the Nervous System, by J. P. MORAT. Authorized English edition translated and edited by H. W. Syers. 263 illustrations. W. T. Keener & Co., Chicago, 1906. pp. 680.

This great work is a part of the more comprehensive treatise on physiology by Morat and Doyon. The author premises that it is the nervous system which decides at what moment the energy accumulated by the living being shall be liberated, that is, shall leave matter

and exert its motor functions. This point it decides with the aid of the senses and by often a lengthy inner elaboration. The cycle of nervous current implies impression from without, sensation within, and motor response, and lastly changed impressions due to movement. In the nervous system all movement induces sensation and all sensation induces movement. It has a marvellous attribute of adjourning its events until the appropriate moment. From the fact of the introduction of sensation into the cycle, events assume a peculiar meaning. The tonality is either pleasurable or painful, the former always preferred to the latter. Sensation seems to modify the relation between cause and effect. External events are preserved by being reduced to representation. It is a false impression that the end and aim of an act is its cause, for the latter must precede and not follow the former. Thus physiology gives rise to psychological problems which are out of its domain. The author first treats of sensibility in its relations to energy, determinism, organization, excitability and reaction; he then distinguishes between static and dynamic unity, and the first chapter starts with an account of the static condition of the neurons, including their dynamism, individuality, forms, functions, degeneration and stimulation; then the energies of the nerve with the current of repose, action and negative variation, fatigue, electrotonus, laws of contraction and nerve poisons, are discussed. Under organization the author treats sensibility and movement in their relations, beginning with nerve pairs, and then discussing spinal nerves and metamerism, cranial or sensory nerves, their inter-relations; then the glossopharyngeal, pneumogastric and the hypoglossal. In the next chapter the indication of impulses and the reflex act, together with inhibition, conservation of stimuli, etc., are discussed. Then come consciousness and unconsciousness, animal and organic life, cerebralization of the stimulus, respiration, circulation, secretion. The next chapter treats of orientation, equilibrium, the emotions, intelligence in its relation to the brain, localization, etc. Then come specific innervations, tactile, visual, auditory, olfactory and gustatory, and lastly language and its defects, idealization, association and sleep. Altogether it is a book of very great importance, is well up to date and should be on the reference shelf of every psychologist. Its 263 illustrations are well chosen and the index and literature, so far as we have observed are well made.

The Subconscious, by JOSEPH JASTROW. Houghton, Mifflin & Co. Boston, 1906. pp. 549.

Professor Jastrow has performed a very useful service in bringing together the results of the recent very copious literature upon the unconscious and presenting it with many well chosen quotations in an interesting way which is at once scientific and popular. The book is timely, will be welcomed and read by every psychologist in the land, and probably will, as it certainly should, have a large sale among the rapidly growing class of laymen interested in the subjects it treats. He divides his chapters into three parts—normal, abnormal and theoretical. He first treats the function of consciousness, its relation to the nervous system and to volition and its mechanism and the distribution of attention, the subconscious in mental procedure and in maturing thought, lapses of consciousness, and finally self-consciousness itself. The second part seeks to define the range of the abnormal; discusses dream consciousness and its variants, dissociation, the genesis of altered personality and its disintegrating lapses. The third treats of the general concept of the subconscious, its abnormal forms, and draws conclusions.

It is impossible here to do justice to a work so lucid, comprehensive

and many-sided, for only an epitome of the whole would be adequate. The author's general conclusion may, however, be summarized. Man does not live by consciousness alone, for older and deeper than it are the dispositions which make the basis upon which it has been developed, meet some needs not adequately provided for by inherited endowment. Its supreme function is the integration of experience. Although liable to disintegration it is essentially a unifying function. The author sees the intimate relation of subconscious activity to mental evolution which is its only key. He recognizes that while the lines of tendency converge toward one normal product the paths of dissolution are puzzlingly divergent. Thus he does not accept as fundamental any scheme of conflicting personalities. He believes that the soul is full of short-circuit processes, so that experience is a mixture of long- and shorthand characters that are not stenographic records of experience at all, but are an independent alphabet. On this view, hypnosis shows a power of knowledge revealed below the threshold that has no origin in the experience of the individual. The theory of a subliminal self, however, is not entirely satisfactory. It could hardly be explained as atavistic because this means survival from below and not culling from above. The practical point of it all is that consciousness and endeavor should occasionally be allowed to lapse and we should allow "the surgings from below to assert their influence," or we should cease to strive and fall back upon the corrective support of the unconscious. "The knowledge that is conscious goes and the wisdom lingers in the subconscious traits of character."

The Problem of Psychiatry in the Functional Psychoses, by EDWARD COWLES. American Journal of Insanity, Vol. LXII, No. 2, October, 1905, pp. 189-237.

Dr. Edward Cowles occupies a unique position to-day in American psychiatry. The founder of the first school for nurses for the hospitals for the insane, the pioneer in this country in introducing experimental methods into the hospital itself, a tried administrator for many years of perhaps the richest and the most elegant hospital in the world and an original contributor to his department, he occupies to-day an eminent and enviable rank, and it is to be greatly hoped that he will bring to maturity and to systematic presentation his own manifold studies. By a singular irony of fate, the very man who was the first in this country to see the importance of establishing clinical and scientific laboratories where chemical, neurological and even psychophysical tests and experiments could be made, and who led this movement, was, at one time, a little in danger of being regarded by a few of the younger men, some of whom had been brought up under him, as critical of their own extreme structural methods of interpretation. A wave of very injudicious economy in the board he had so long served prompted him, at about the same time, to withdraw from it. If he had yielded at this rather discouraging point, it might almost have been said of him as of Jubal, who first taught his people music and was later rejected from a great concert, so that forgotten he lay down to die, while his great art and even his name filled the sky. But this is not what happened, for Dr. Cowles has with great discretion and courage kept on writing and growing. His view as defined in the above article seems to us to represent about the sanest view to be found in the whole field and the view that is to prevail. More than this, psychiatry is now taking a rather sharp and sudden trend, so that whereas structure has led and been dominant, now function is coming to the fore. The old dogma that no psychic disease was known or even established unless the post mortem findings showed

some lesion is everywhere giving way to a broader and more psychological view. Joinet's visit to this country was most opportune in this respect and there is a prospect that morphology and the study of brain lesions will be relegated to their true and just position. This is precisely what Dr. Cowles has stood for, as all those who have known his career for many years will testify, and psychologists as well as the most progressive psychiatrists now acknowledge the eminent value of his services. This paper, which it is hoped is only the first of a series setting forth in greater fullness his views, discusses precisely these issues, between those who study insanity chiefly from the cerebral side and those who approach it chiefly from the functional side.

The Evolution of Knowledge. A review of Philosophy. By RAYMOND ST. JAMES PERRIN. The Baker & Taylor Co., New York, 1905. pp. 308.

This book originated in a student production in 1881 in which the author aimed to show that space, time, matter and force can be resolved into motion. Since then several other works have elaborated this thesis and here we find motion to be the ultimate reality. In the first part of the present book, he traces this idea from Thales down to Cousin, Comte, Reade and Hamilton and in the second part he describes the evolutionary philosophy of Herbert Spencer and George Henry Lewes. The author is a vigorous believer in religion, regrets that specialization has separated the forces of instinct and reason, but believes they are destined to reunite in the evolution of knowledge. Old creeds fail to inspire us because they have ceased to represent nature. The chief enemies of the church are zealots. The central problem of education is the proper use of fiction. Yet the imagination should not be stimulated at the expense of the truth.

Christianity and Sex Problems, by HUGH NORTHCOTE. F. A. Davis Co., Philadelphia, 1906. pp. 257.

This is a truly remarkable work. It treats sexuality in childhood, the mixing of the sexes in schools and elsewhere, the battle of chastity in the adult, neo-Malthusianism, fornication, venereal diseases in legislation, marriage, modesty, divorce, the sexual in art, sex perversion, impure language, the gospel and sex relations, etc. These titles, however, give little idea of the contents of the book. The author wishes to see a new ethics of the sexes developed and thinks it is being slowly evolved. It is a hard study, implying knowledge of anthropology, biology, medicine, law, theology, psychology, etc. The student must go through many pages so vile as to try his nerves, and needs to be highly endowed with the moral qualities of tact and caution for the subject is a dangerous one. The sexual evil of our day is painted by Northcote in very lurid colors, but our author's treatment of the whole subject throughout is permeated with a religious sentiment. He believes that it is one, if not the chief, function of religion to keep this passion pure and exalted and hold it true to its purpose. While he has himself evidently gone through the most repulsive chapters, this study has not contributed in the least to diminish his reverence—nay, almost worship—for the subject. He sees educational possibilities here higher perhaps than any one else has yet detected, and holds that religion and sexual life must go together, that they rise and fall with each other, and either can be kept pure only by the other. There is much plain language in this book, but, on the whole, none of the plain books on this subject are perhaps better suited to the needs of, let us say, thoughtful men of collegiate grades.

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